Beyond Cognition: Examination of Iowa Gambling Task Performance, Negative Affective Decision-Making and High-Risk Behaviors Among Incarcerated Male Youth

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ABSTRACT

Beyond Cognition: Examination of Iowa Gambling Task Performance, Negative Affective Decision-Making and High-Risk Behaviors Among Incarcerated Male Youth

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This paper is based on a study examining the performance on the Iowa Gambling Task (IGT) of a group of male adolescents aged 16-18 years incarcerated at a secure corrections facility located near New York City. At the time of IGT administration, 45% of the study participants had been charged with crimes but not yet sentenced; 55% of the study participants had been sentenced. 61% of the subjects had been charged with having committed violent felonies and 39% of the subjects had been charged with committing non-violent felonies or misdemeanors.

In an effort to contextualize the results of the study sample's performance on the IGT, participant performance was compared to the IGT performance of two groups of adolescents that had never been incarcerated ($N = 42$, $N = 31$). Findings demonstrate that the study sample performed significantly worse on the IGT than the community-based samples. Study participant performance was also compared to IGT performance of a group of previously incarcerated adults ($N = 25$). There was no statistically significant difference in the mean performances of these groups. The study also examined the relationship between antisocial behavior and psychopathic traits and decision-making (as measured by the IGT). No significant differences on IGT performance were identified between study participants charged with committing violent felonies and study participants charged with non-violent felonies and misdemeanors. No association was

found between the presence or absence of psychopathic traits, specifically callous-unemotional traits, and IGT performance. Implications for research and practice are considered.

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CHAPTER 1

INTRODUCTION

Many of the paradigms espoused for thinking about human behavior by social scientists in the United States assume, as a baseline, that individuals generally make decisions based on rational choices reflecting a reasoned analysis of potential costs and benefits and how best to minimize the former and maximize the later. In fact, decision-making is a multi-dimensional process that can be analyzed from a number of different perspectives including, but not limited to, the level of neuropsychological development, the existence of pathology, the influence of social and environmental factors, and the intersection of emotion and reason. The goal of this paper is to contribute to the existing body of research and literature concerning decision-making by adolescents, especially those adolescents whose decisions have led them to engage in high-risk behavior to a greater extent than their peers in the rest of the community. The broader aim of such research is to develop a deeper understanding of risk-taking and decision-making by adolescents with the purpose of helping to shape effective prevention and intervention programs that may help adolescents avoid behaviors that may lead to long-lasting negative consequences for the adolescent, his or her family, and the community at large.

Adolescence, the developmental stage between childhood and adulthood, is a time of significant physical, and usually, emotional change. In the United States, the period is generally considered a time of experimentation, and often emotional stress. Many people engage in risk-taking behaviors during adolescence, some of them relatively safe, and some of them entirely unhealthy. Developmental and psychology researchers historically explained adolescents' propensity for risk-taking and, compared to healthy adults, relatively poor decision-making, as a result of adolescents' inferior cognitive reasoning abilities. However, recent neurodevelopmental

research suggests that, on average, adolescents tend to be as cognitively adept as adults at perceiving and estimating their own vulnerability to risk suggesting that other factors may be contributing to adolescents' propensity for risky decision-making. Neurodevelopmental researchers have suggested an alternate explanation for poor decision-making by adolescents: under emotionally salient and risky conditions, adolescents have limited ability to coordinate emotion and reason. Neurodevelopmental researchers have highlighted several relevant areas of brain impairment, or, in contrast heightened sensitivity, which during adolescence may contribute to adolescent reactions to situations involving risk. These themes will be described in this paper.

Adolescents that engage in antisocial behavior represent a population that many people characterize as "poor decision-makers." To hope to aid this group requires an understanding of some of the causes of, or factors that tend to contribute to risk-taking behaviors and antisocial acts by adolescents. To this end, researchers have strived to identify ways of differentiating among types of antisocial adolescent patterns of behavior. A principal measure of differentiation has been the age of onset of antisocial behavior, largely attributable to the Developmental Taxonomic Theory of Antisocial Behavior (Moffitt, 1993). A more recently proposed basis for further differentiation among persons who begin exhibiting antisocial behavior during adolescence is the presence or absence of psychopathic traits, a concept examined further in the following sections of this paper. In particular, researchers have identified "callous-unemotional" (or CU) traits as an indicator of propensity for antisocial behavior among adolescents. The current study examines the association between adolescent decision-making and the presence or absence of CU traits on a task of affective decision-making, the Iowa Gambling Task, by a group

of male adolescents, aged 16-18, incarcerated at the time of the study at the Rikers Island Correctional Facility in New York.

The group of subjects that participated in the current study represents a population "at risk" for long-term negative consequences as a result of poor decisions made during adolescence. Continued research is needed to better understand why this group of young persons, and others like them chose to engage in high-risk behaviors that may ultimately create serious problems in their lives, as well as negatively affect their peers, families, and larger communities. Only once a fuller picture of how such adolescents make decisions is achieved, can researchers, psychologists, therapists, and correctional facility staff, public policy makers and others better understand how to help adolescents avoid permanent, high-risk taking without squelching more beneficial, healthy experimentation and challenge-seeking.

What follows provides an overview of the major theories of rational decision-making and the recognition of how emotions influence decision-making. An outline of typical adolescent development in relation to decision-making and risk-behaviors will be presented, followed by a description of the general population of antisocial youth in the United States, with a specific focus on incarcerated adolescents. Next, the development of the concept of psychopathy will be discussed, along with its extension to CU traits, and its importance in differentiating within antisocial and delinquent youth, a more severe and aggressive subgroup. In addition, I will present an outline of a relevant theoretical framework for the development of psychopathy and psychopathic traits and current empirical literature to support this framework from studies using children and adolescents from both community and juvenile offending samples. Lastly, a study is presented that examined the role of CU traits on an affective decision-making task among a sample of incarcerated male adolescents from Rikers Island Correctional Facility in New York.

DECISION-MAKING

Cognitive Theories of Decision-Making and Risk-Taking

Most decisions involve some degree of uncertainty or conflict. In order to gain insight into how individuals make decisions when faced with this uncertainty or conflict, theories of decision-making have developed which model possible outcomes based on associated numerical values (Shafir, Simonson, & Tveresky, 1993). The cognitive study of decision-making has a long history dating back to probabilistic theories developed in the seventeenth century. Probabilistic theories assume that a decision-maker uses rational principals to estimate probable costs and benefits associated with various outcomes to guide the decision-making process (Reyna & Farley, 2006). Thus, a decision-maker will theoretically select an outcome associated with maximal value. Probabilistic or cognitive theories of decision-making were developed using monetary gambles in which outcomes were modeled based on the sum of the probabilities. Gambles represent simple models of decision-making under conditions of uncertainty and risk, which are useful to the study of decision-making in daily life as almost all decisions involve uncertainty and risk (Kahneman, 2011).

Expected Utility Theory. Expected Utility Theory (EU theory), which is currently one of the most widely accepted theories of individual rational decision-making under risk in the social sciences (and particularly economics), was developed in line with probabilistic theories. EU theory is premised upon work initiated by Daniel Bernoulli in the mid-1700s and was later revived by John von Neumann and Oskar Morgenstern (1947) as an economic theory describing rational decision-making. In a simple gamble, people tend to select an outcome based on the utility associated with that option. The utility, or subjective value an individual subscribes to an amount of money, is calculated by summing the utilities associated with all possible outcomes,

weighted by the probability of each outcome. Utilities can be modeled as functions to indicate preferences for risk-averse and risk-prone behavior. For example, a concave utility function represents risk averse selections such that the decision-maker will always prefer a certain amount to any risky prospect with the same expected value. A convex utility function represents risk prone selections (Starmer, 2000). In EU theory it is postulated that individuals generally dislike risk. Returning to a simple gamble example, most people would decide to select a certain amount rather than a gamble with an expected value that is equivalent to the certain amount (Kahneman, 2011). EU theory offers a simple and powerful modeling tool for considering decision-making under uncertain conditions; however, there are several limitations to applying EU theory to real-life decision-making. Some of these limitations have been addressed by Prospect Theory.

Prospect Theory. As observed by Tversky and Kahneman (1981), in daily life people systematically violate the rules of rational decision-making. Prospect Theory (PT), developed by Kahneman and Tversky (1982), was proposed to address the limitations of EU theory. A major advance of PT is the recognition that most people respond differently towards gambles involving gain and those involving loss. One of the most famous examples of how individuals generally hold different attitudes toward gains and losses was constructed by Tversky and Kahneman (1981). Study participants were told to imagine that the U.S. is preparing for an outbreak of an unusual disease and two programs have been proposed to combat the disease. One group of study participants was given a decision framed in gains: if the first program is utilized, 200 people will be saved. If the second program is adopted, there is a one third probability that 600 people will be saved and a two thirds probability that no one will be saved. The majority of participants adopted a risk-averse strategy and opted to save 200 people rather than select an outcome where there is the possibility that no one will be saved. A second group of study participants was given

a decision framed in losses: either 400 people will die or there is a one third probability that no one die and a two thirds probability that 600 people will die. The majority of participants in the second group selected the second, risk seeking, option. As demonstrated in the above example, when given a decision between a certain gain and a gamble with the same expected value, most people will select the certain gain demonstrating a risk-averse decision-making style. In contrast, when faced with a decision involving a certain loss and a gamble, people are much more likely to become risk seeking and select the gamble.

Two predominately cognitive theories of decision-making under risk and uncertainty were presented to provide a rational model for how people evaluate decisions. EU theory provided a model posited on rules of rationality, which suggests that people weigh outcomes in decisions based on utility, or the subjective value subscribed to an outcome. Utilities can be modeled according to mathematical principles integrating rational axioms. PT represents a more complex model of decision-making that incorporates the differing attitudes that most individuals hold towards gains and losses. Cognitive models of decision-making lay out principles of decision-making under risky or uncertain conditions that can be used as a framework to gain insight into everyday human decision-making. However, cognitive theories of decision-making are unable to incorporate the influence of emotion on the decision-making process. The next section presents a predominant theory of affective decision-making.

The Role of Emotion in Decision-Making

Studying theories of rational decision-making offers an important starting point to understanding the cognitive process related to decision-making. However, in day-to-day life, human beings rarely make decisions based solely on logic. Emotions influence the decision-

making process, guiding individuals to make choices or take risks that rationally do not make logical sense.

The somatic-marker hypothesis (SMH), a predominant theory proposed by Damasio (1994), is among the theories to recognize the role of affect in decision-making. The SMH, in essence, posits that decision-making in situations of complexity and uncertainty is guided by emotional responses to anticipated positive and negative consequences, which Damasio termed "somatic markers." Indicators of somatic markers include changes in the visceral state such as alterations in heart rate or blood pressure and gut motility (Reimann & Bechara, 2010). Researchers hypothesize that somatic signals are mediated by regions of the brain that include the orbital frontal cortex and the ventromedial prefrontal (vmPFC) cortex, which are involved in the regulation and modulation of emotional behavior (Blair, 2006; Damasio, 1994). A decision-maker may or may not be conscious of the influence of somatic markers on his or her thought process and may not be aware of the extent to which his or her actions are guided by, or reflective of, somatic signals. Somatic markers guide behavior by creating visceral sensations of the type described above, which in turn, suggest to the decision-maker which of a group of potential choices are advantageous and which are disadvantageous. In this way, somatic markers facilitate decision-making by reducing the number of options a decision-maker considers as possibilities (Syngelaki, Moore, Savage, Fairchild, & Van Goozen, 2009).

The SMH was developed by Damasio based on his work with patients with vmPFC lesions, who manifested difficulties with social interactions, failure to plan ahead, irresponsibility, and "acquired sociopathy" (Schmitt, Brinkley, & Newman, 1999). Damasio (1994) postulated that vmPFC impairment among his subjects would result in impaired ability to generate, or develop autonomic responses based upon somatic marker signals, resulting in

deficient affective decision-making. Most of the evidence supporting the SMH is based on analyses of study participants' performance on the Iowa Gambling Task (IGT), a measure of affective decision-making developed by Bechara, Damasio, Damasio, and Anderson (1994). Studies of the IGT have demonstrated that task performance is influenced by subjects' ability to form and respond to somatic markers or emotional cues. Over the course of the administration of the IGT, healthy adults tend to use emotional cues to guide their decision-making. In particular, researchers have noted that individuals who are able to generate and respond to somatic cues are more likely than other subjects to adapt their choices over the course of the IGT task to select outcomes associated with long-term positive results. In contrast, without emotional cues, especially visceral signals, study participants are less able to adjust their task performance based on negative feedback.

Social and Environmental Influences on Decision-Making

There are a large number of factors that influence the decisions presented by a person's day-to-day life and the way a person chooses to respond to those decisions. Environmental and contextual factors partially determine access and opportunity to engage in high-risk decisions and behaviors. These factors may include problems with family environment (i.e., harsh or inconsistent parenting, inadequate supervision, mental health issues), peer affiliations, and neighborhood environment. Studies have reported links between socioeconomic status (SES) and antisocial behavior, as economic status may limit an individuals' ability to engage in pro-social behaviors to obtain goals (Blair, 2006). Exposure to community crime and racial discrimination are associated with offending behaviors (Simons and Burt, 2011). In a study by Furr-Holden, Milam, Reynolds, MacPherson, and Lejuez (2012), researchers found that participants who rated

their neighborhoods as more disorderly were more likely to make increasingly risky decisions on a computerized measure of decision-making.

DECISION-MAKING AND RISK-TAKING DURING ADOLESCENCE

For many young people, adolescence is a period of experimentation and novelty seeking. Seeking out new experiences and trying unfamiliar activities or modes of behavior can have positive implications. Indeed, evolutionary theories support the adaptive facets of risk-taking – for example, novelty-seeking behaviors may have encouraged our ancestors to secure physical resources, explore new territories and attract mates (Spear, 2000). Within certain limitations and boundaries, attempting new activities and facing novel challenges allow for discovery of innate talents and strengths. Learning to navigate unfamiliar situations and take risks can assist in the development of traits such as resilience and flexibility.

At the same time, not all novelty-seeking behaviors have positive results. Adolescence is a period when many young people tend to experiment with, and in some cases begin to indulge routinely in, high-risk behaviors such as over consumption of alcohol, use of drugs, unsafe sexual practices, criminal activity, and reckless driving (Centers for Disease Control and Prevention, 2011; Figner, Mackinlay, Wilkening, & Weber, 2009). High-risk behaviors of this kind can have lasting detrimental effects on health and emotional stability and lead to legal, financial and educational problems. Though most adolescents engage, at some point, in high-risk behavior or poor decision-making, there is great variation in the frequency and extent of such behaviors, as well as the corresponding consequences.

Definitions

This paper employs the definition of "adolescence" of the World Health Organization, which uses the term to refer to the second decade of life (10–19 years of age).

Adolescence has not always been recognized as a distinct developmental phase – traditionally, researchers and theorists focused work related to development almost exclusively on childhood and adulthood. G. Stanley Hall was one of the first to identify adolescence as a developmental phase separate from childhood or adulthood. Hall pioneered the idea in "Adolescence: Its Psychology and its Relation to Physiology, Anthropology, Sociology, Sex, Crime, Religion and Education," published in 1904. In that work, Hall described adolescence as a period of "sturm and drang," or storm and stress. The characterization of adolescence as a tumultuous developmental period has been reinforced by many influential psychologists throughout the twentieth century, including Erik Erikson and Anna Freud. Contemporary researchers and psychologists generally accept that adolescence is a period of behavioral, cognitive, social, and emotional changes (Steinberg, 2008). Most young people experience significant physical changes during adolescence, including puberty, and for many, adolescence presents a host of previously unfamiliar social situations. Frequently, adolescence is a period that involves newfound independence (or a new degree of independence) from the family unit and stronger identification with peers (Dobbs, 2011).

Cognitive Theories of Decision-Making and Risk-Taking during Adolescence

Predominant historical models of adolescent risk-taking and decision-making focused primarily on cognitive ability, namely the ability to comprehend relevant information and logically process that information to arrive at a choice (Scott & Steinberg, 2008). Historical models of adolescent risk-taking tended to attribute differences between adolescent and adult decision-making to adolescents' perceived inferior cognitive abilities – i.e., inferior abilities to rationally evaluate possible consequences and the probability of outcomes. Indeed, many well-regarded theorists attributed adolescents' greater propensity for poor decision-making, as

compared with adults, to their ignorance, irrationality and delusions of invulnerability relative to adults (Reyna, 2008; Steinberg, 2008).

More recent research suggests that adolescents are, in fact, generally as cognitively adept as adults at perceiving and estimating their own vulnerability to risk. A study published by Steinberg (2008) illustrates the point – Steinberg found that the logical reasoning and basic information processing abilities of average 16 year olds are comparable to those of typical adults.

If, in fact, adolescents and adults do have comparable cognitive reasoning abilities related to estimation of risk and related consequences, what, then, explains poor decision-making by adolescents relative to adults? As asserted by Fischhoff (2008), though adolescents may possess cognitive capabilities similar to those of adults, this does not guarantee that adolescents make use of those skills in the same ways as adults.

Furthermore, a growing body of research recognizes the interaction between cognitive, social and emotional factors as crucial aspects of risk behavior analysis. For example, the theory of "cognition-in-context" described by Steinberg and Cauffman, 1996, and Steinberg, 2009, emphasizes the role of social and emotional factors, and the interactions between those factors and cognitive reasoning skills, in adolescent decision-making. Research suggests that social and emotional influences are especially relevant to adolescents because they are more susceptible than adults to be influenced by these factors (Gardner and Steinberg's 2005 study, for example, highlights the influence of peer relationships on adolescent risk-taking behaviors). Neurodevelopmental findings regarding decision-making during adolescence are described in further detail below.

Neuroanatomical Changes during Adolescence

As noted above, neurodevelopmental research tends to support the idea that adolescent risk-taking behavior is generally not simply a product of immature cognitive reasoning abilities. Neurodevelopmental research provides an alternative explanation: the asynchronous development of, and, perhaps, impaired functioning of, regions of the brain responsible for processing information about risk and combining that information with emotional reasoning and other inputs, may explain adolescents' propensity to engage in high-risk behaviors and exhibit poor decision-making relative to typical adults and even children.

The "normal" brain undergoes significant neuroanatomical and neurochemical remodeling during adolescence. Three major neuroanatomical structural changes occur during adolescence (Paus, 2005; Steinberg, 2008). First, beginning in preadolescence and continuing into early adolescence, there is a decrease in grey matter in prefrontal regions of the brain reflective of synaptic pruning. As unused neural connections are eliminated, there are associated improvements in logical reasoning and information processing. The second major structural change is an increase in white matter as a result of myelination of nerve fibers in the same prefrontal regions of the brain described in connection with the first structural change, a process that continues until early adulthood. This structural change results in greater connectivity within the prefrontal region of the brain, leading to corresponding improvement in executive functioning skills such as planning, evaluating risk and reward, and inhibiting reward responses. A third principal structural change that typically occurs during adolescence is a proliferation of white matter tract projections across different brain regions, leading to further increases in connectivity between the cortical and subcortical regions and across various cortical areas. This improved cross-region connectivity allows for better coordination of emotional processing and

cognitive control processes. In addition to the three major structural neuroanatomical changes that normally occur during adolescence, young people also typically experience neurotransmitter and neurochemical changes including alterations to the dopaminergic, serotonergic, glutamate, and GABA neurotransmitter systems (Spear, 2000).

Described below is a model that explains how neurodevelopmental changes during adolescence lead to different risk-taking and decision-making patterns during adolescence as compared to childhood and adulthood.

The "Dual Systems" Model of Neurodevelopment

In 2008, Casey, Getz, and Galvan introduced a model, also supported by Steinberg (2008), describing adolescent decision-making and risk-taking behavior in terms of the neurodevelopmental changes occurring in adolescence. In contrast with earlier models of adolescent neurodevelopment, which focused principally on maturation of the prefrontal cortex and its effects on cognition, Casey et al. "dual systems" model incorporates both the cortical and subcortical regions of the brain. The dual systems model posits that heightened frequency of poor decision-making and high-risk behavior among adolescents, compared to children and adults, may be largely the result of asynchronous development of the subcortical and cortical regions of the brain during the adolescent stage of development.

As its name implies, the "dual systems" model of neurodevelopment during adolescence explains adolescent decision-making tendencies by considering the development of two principal brain systems during the adolescent period. The first brain system incorporated in the dual systems model is the "socio-emotional system." The socio-emotional system is another name for the limbic subcortical system, which includes the amygdala, ventral striatum, orbitofrontal cortex, medial prefrontal cortex, and superior temporal sulcus (Steinberg, 2009). This brain

system matures more quickly than other areas of the brain. The limbic subcortical system controls social and emotional information processing, in part, through interactions with a number of other areas of the brain and, with these other systems, influences perception of saliency of rewards and punishments. Adolescences' heightened sensitivity to rewards (or reduced sensitivity to punishment) compared to adults' influences their decision-making and risk-taking behaviors. Evidence of the role of the subcortical region and resulting effects on saliency of punishment and reward as an influence upon adolescent decision-making was confirmed by the results of a study conducted by Steinberg (2008). Similarly, in 2006, Galvan et al., found heightened activation in the ventral striatum, a neural region of the limbic subcortical system involved in the evaluation of rewards, during adolescence. Research also demonstrates that typical adolescents experience rapid increases and redistribution of dopaminergic activity within their limbic subcortical systems, with related projections to the prefrontal area, which is postulated to be associated with frequency of reward and sensation-seeking behaviors (Steinberg, 2008; 2009).

The second brain system incorporated in the dual systems model is the "cognitive control" system. The cognitive control system governs the coordination of affect and cognition, thereby influencing ability to regulate emotion (Steinberg, 2009). The cognitive control system is comprised of the cortical region, including the prefrontal cortex and the parietal cortices. In comparison to the subcortical region of the brain, the prefrontal cortex matures relatively slowly.

Steinberg and other researchers have postulated that the differential maturities of the socio-emotional system and the cognitive control system create a period of "heightened vulnerability" during which adolescents have limited ability to coordinate emotion and reason in decision-making (Steinberg, 2009). This "heightened vulnerability," when coupled with

emotional arousal, can prove especially challenging to adolescents' decision-making capabilities. In contrast to the adolescent period, during childhood and adulthood, the limbic subcortical and cognitive control systems of the brain are generally of more similar maturities, yielding a more balanced influence over behavior (Somerville, Jones, & Casey, 2010).

Summary

In summary, adolescence is a developmental period often associated with high-risk behaviors and poor decision-making. Historical theorists have attributed this phenomenon to adolescents' inferior cognitive abilities. However, recent neurodevelopmental research indicates that, in fact, adolescents generally possess cognitive reasoning skills commensurate to adults, including their ability to evaluate and perceive risks. The "dual systems" model posits an explanation for why, despite their similar cognitive capabilities to adults, adolescents are more likely than adults to demonstrate high-risk behaviors and poor decision-making: the relative immaturity of cognitive control systems of the brain compared with other brain functions during the adolescent phase. This asynchrony likely contributes to poor decisions that often reflect adolescents' compromised abilities to coordinate logical reasoning skills with emotions. Given the serious, and sometimes lifelong, consequences of engaging in these behaviors, it is critical to continue to examine why some adolescents persist in engaging in high-risk behaviors. Related, in the next section, a description of youth who consistently engage in the most high-risk and antisocial behavior will follow.

ANTISOCIAL BEHAVIOR AND DECISION-MAKING

Definitions

This dissertation uses the term "antisocial behavior" to refer to a range of actions and attitudes that violate societal norms (Burt, Donnellan, Iacono, & McGue, 2011). Examples of

antisocial behaviors committed by children and youth include theft, running away from home, bullying, fire setting, and cruelty to animals. “Delinquency” is a type of antisocial behavior that generally connotes illegal actions, often, more specifically, actions that, if committed on a large scale, or with significant consequences, would be considered criminal (specifically if committed by adults, as opposed to younger persons) (Retrieved from http:www.nycourts.gov/).

Adolescents do commit actions that constitute crimes in the United States justice system. Indeed, adolescents represent a significant portion of persons incarcerated in the US. The US Office of Juvenile Justice and Delinquency Prevention (OJJDP) reported that in 2008, juveniles (which the OJJDP defines as persons younger than 18) accounted for 16% of all violent crime arrests and 26% of all property crime arrests in the United States. During the same year, over two million persons under the age of 18 were arrested in the US (OJJDP, 2009). Over 70% of the persons under 18 years old that the OJJDP reported as having been arrested in 2008 were male. In 2009, adolescents comprised six percent of the total jail population reported by the New York City Department of Corrections. Of these adolescents, 72% had been charged with violent felonies; the crimes for which the adolescents had most frequently been charged included robbery, homicide, assault, and weapons possession (Retrieved from www.nyc.gov/html/doc). Additionally, adolescents that engage in delinquent or criminal acts are relatively likely to be repeat offenders. Moffitt (1993) reported that the most persistent five to six percent of youthful offenders account for more than fifty percent of reported crimes among youth.

Adolescents with criminal records also represent a group that exhibits more frequent incidences of serious and extra-judicial health issues than adolescents in the community. Compared to the general population, youth with criminal histories have disproportionately high rates of sexually transmitted infections and engagement in behaviors putting them at high risk for

HIV and AIDS, substance use disorders, and psychological and other major health problems (Fazel, Doll, & Langstrom, 2008; Forrest, Tambor, Riley, Ensminger, & Starfield, 2000; Teplin, Abram, McClelland, Dulcan, & Mericle, 2002; Teplin, Elkington, McClelland, Abram, Mericle, & Washburn, 2005). Relatedly, these youth are also disproportionately more likely to reside in neighborhoods characterized by higher levels of poverty, economic inequality, and restricted access to quality schools and employment opportunities further placing these youth at increased risk for engagement in delinquent and other high-risk behaviors (Freudenberg et al., 2010). For example, in the New York City area, 14 of the most impoverished neighborhoods account for 50% of all the New York City jail discharges (Mellow et al., 2008).

Developmental Taxonomic Theory of Antisocial Behavior

Given the heterogeneity of actions referred to under the general heading "antisocial behavior," researchers have attempted to organize antisocial behaviors into meaningful categories, with the ultimate goal of developing effective prevention and treatment interventions. Consistent evidence has demonstrated that there are many different causes of antisocial behavior, and, to better understand antisocial behavior, researchers and clinicians need to be able divide youth into groups based on the reasons or explanations for their antisocial behavior.

In 1993, Moffitt proposed "The Developmental Taxonomic Theory of Antisocial Behavior," one of the most recent influential theoretical schemas for categorizing antisocial behavior. Moffitt's theory differentiates between antisocial behaviors that manifest during childhood and those that manifest during adolescence.

As what was, perhaps, the basis for formulating this theory, Moffitt and others observed that antisocial behavior that commences during childhood tends to be associated with severe, violent, and aggressive patterns of behavior, often persisting into adulthood. Childhood onset of

antisocial behavior is also associated with familial instability, conflict, maltreatment, and ineffective parenting techniques (Cicchetti, Rogosch, & Thibodeau, 2012; Frick & Viding, 2009; Jaffee, Caspi, Moffitt, & Taylor, 2004). Some researchers have suggested that antisocial behavior commencing during childhood may also reflect impaired executive functioning and lower intellectual abilities. An antisocial child's temperament, combined with one or more of the aforementioned factors, may disrupt the child's socialization process, leading, in some cases, to enduring vulnerabilities and long-lasting tendencies towards antisocial behaviors (Frick & Marsee, 2006).

In contrast, antisocial behavior commencing during adolescence tends to be less violent and is less frequently persistent into adulthood. It is hypothesized that antisocial behavior exhibited, in the first instance, during adolescence, is more likely reflective of exaggerated versions of typical adolescent deviance than it is indicative of more entrenched, permanent psychological or psychosocial impairments (Frick & Viding, 2009). According to Moffitt's theory, antisocial behavior emerging during adolescence often represents social mimicry arising, in part, based on peer pressure, as opposed to behavior that is indicative of the biological, environmental, and cognitive deficits associated with childhood onset antisocial behavior.

Since its introduction in 1993, Moffitt's theory has been supported by the results of several longitudinal research studies. Among these is a New Zealand study involving a group of antisocial persons, some of whom displayed antisocial behavior beginning in childhood and some of whom, first displayed antisocial behavior during adolescence. The results of this study demonstrated that persons who exhibited antisocial behavior beginning during childhood were more likely to be convicted of criminal acts during adulthood than persons who exhibited antisocial behavior beginning in adolescence (Moffitt, Caspi, Harrington, & Milne, 2002).

Moffitt's theory is also supported by neurological imaging research that has shown reduced amygdale gray matter volume and temporal lobe volume in male children and adolescents who met criteria for early-onset conduct disorder (Huebner et al., 2008; Kruesi, Casanova, Mannheim, & Johnson-Bilder, 2004; Sterzer, Stadler, Poustka, & Kleinschmidt, 2007).

Differentiating Childhood Onset Antisocial Youth Based on CU Traits

Since the introduction of Moffitt's theory, other theorists have attempted to differentiate among types or categories of antisocial behavior within the two original categories suggested by Moffitt (childhood onset versus adolescent onset of antisocial behavior). Frick and Viding (2009) proposed one such basis for differentiation among antisocial behavior styles exhibited beginning in childhood: the presence or absence of callous-unemotional (CU) traits.

The next section of this paper examines psychopathy, especially the presence or absence of CU traits, as a framework for distinguishing among the subcategory of persons that Moffitt identified as antisocial individuals that started to display delinquent and antisocial behaviors during childhood.

IMPAIRED DECISION-MAKING AMONG PERSONS WITH PSYCHOPATHIC AND CU TRAITS

The next sections of this dissertation examine the application of the construct of psychopathy, and, in particular, the presence or absence of CU traits, to decision-making by adolescents who exhibit poor decision-making and engage in high-risk behaviors. As part of this discussion, the paper describes the Integrated Emotions System (IES) theory of the development of psychopathy and how the elements of the IES may explain the performance of adolescents with antisocial tendencies, and in some cases, CU traits, on measures of decision-making such as the IGT.

Psychopathy

Definition. Hervey Cleckley's 1941 book, "The Mask of Sanity," presented the first widely used conceptualization of psychopathy (Hare, 1993). Cleckley outlined 16 characteristics of psychopathy including: superficial charm, lack of guilt or anxiety, dishonesty, failure to form lasting intimate relationships, lack of insight into the impact of one's behavior on others, and failure to plan ahead. Subsequent to Cleckley, psychopathy has become part of mainstream psychological literature, largely as the result of various works by Robert Hare published during the 1980s.

Early formulations of the concept of psychopathy focused on two "core" components: emotional dysfunction and its manifestation in antisocial behavior (Blair & Mitchell, 2009). In the context of these early formulations, "emotional dysfunction" included characteristics such as lack of guilt, empathy, and superficial charm and "antisocial behavior" included impulsivity and delinquency (Blair, Colledge, & Mitchell, 2001). More recent conceptualizations of psychopathy have added a third "core" factor to the original two: "narcissism," which is typified by an arrogant and grandiose interpersonal style (Frick & White, 2008). A fourth "core" factor has also been proposed: "psychopathic behavioral lifestyle," typified by a lack of realistic or long-term goals, proneness to boredom, and a "parasitic" approach to existence and interpersonal relationships (Hare, 2003).

Background: Psychopathy and DSM-IV-TR. The Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition, Text Revision (DSM-IV-TR) does not recognize "psychopathy" as a diagnosis. However, a specifier of CU traits has been proposed as an addition to the diagnostic criteria for Conduct Disorder to be included in the upcoming DSM-V (if included, CU traits would be used in conjunction with current childhood, adolescent and

unspecified onset specifiers) (Frick & Moffitt, 2010). Additionally, there are several psychiatric conditions described in the DSM-IV-TR that include antisocial behavior as a core component including: Conduct Disorder (CD), Oppositional Defiant Disorder (ODD), and Antisocial Personality Disorder (ASPD).

In order to appreciate the utility of "psychopathy," as a construct applied to human behavior, the concept must be distinguished from DSM-IV-TR diagnoses that are associated with antisocial behavior. DSM-IV-TR diagnoses associated with antisocial behavior are descriptors of modes or patterns; they do not take into account emotional dysfunction or CU traits, which are often considered the hallmark of psychopathy (Cooke & Michie, 1997; Hare, 1991). Indeed, research by Harpur, Hare, and Hakstian (1989) confirmed that antisocial behavior associated with ASPD, for example, is differentiable from the interpersonal and affective processes associated with psychopathy. Similarly, other research, such as the work of Frick, O'Brien, Wootton, and McBurnett (1994), has demonstrated that callous-unemotional factors can exist independent of conduct problems such as those that are the subject of DSM-IV-TR diagnoses. While it is certainly true that individuals diagnosed with CD, ODD, or ASPD may also, from time to time, exhibit psychopathic traits, the concept of psychopathy generally refers to more severe and persistent behavioral patterns (Blair, 2010).

Psychopathy among adults. To date, psychopathy, as a construct, has been applied largely to adult populations. For instance, a number of studies have found associations between the presence of psychopathic characteristics and the tendency to demonstrate prolonged patterns of violent and other antisocial behaviors (Porter & Woodworth, 2006). In research concerning incarcerated adults, the presence of psychopathic traits has been found to be associated with likelihood of repeat offenses and severe, violent crimes (Blair et al., 2005). A meta-analysis by

Hemphill, Hare, and Wong (1998) concluded that within a year of release from incarceration, the general recidivism rate for psychopathic adults is three times higher, and the violent recidivism rate was three to five times higher, than among non-psychopathic adults. Blair et al. (2005) have estimated the incidence rate of psychopathy among adult males to be 0.75 percent. In a study published in 1996, Hare estimated the incidence rate of psychopathy among incarcerated adults to be between 15 and 25 percent.

Psychopathic traits among adolescents. Though most of the research on psychopathy to date has almost exclusively involved adult populations, recent research has begun to also apply the concept of psychopathy to younger populations. One early study employing psychopathy as a tool to assess the behavior of youth was completed by Frick et al. (1994), which highlighted that traits similar to those prevalent among adults characterized as exhibiting psychopathic tendencies can also be observed among a subset of antisocial adolescents. These traits include callous-unemotional styles, impulsive and irresponsible decision-making, narcissistic and deceitful interpersonal mannerisms, and other traits correlated with criminal involvement and poor anger control (Frick & White, 2008; Salekin, Brannen, Zalot, Leistico & Neumann, 2006). Adolescents with psychopathic tendencies also exhibit functional impairments analogous to those displayed by psychopathic adults such as deficient responses to emotional expressions, and impaired aversive conditioning, passive avoidance learning, reversal learning and extinction (Blair, 2007). Additionally, in a meta-analysis of almost 100 studies conducted by Leistico, Saleki, DeCoster, and Rogers (2008), it was found that psychopathy moderately predicted negative outcomes such as recidivism and infractions equally well across youth and adults.

Subsequent longitudinal studies have examined the association between psychopathic traits, including CU traits, and age of onset of antisocial behavior. A 1996 study by Moffitt,

Caspi, Dickson, Silva, and Stanton demonstrated that boys who exhibited preadolescent onset of antisocial behavior, and continued to evidence antisocial behavior through young adulthood, were more likely to be characterized as regarding others in a suspicious or cynical manner than boys who first manifested antisocial behavior during adolescence. This finding is consistent with the description of CU traits developed in earlier research concerning adult psychopathy. Similarly, a study by Silverthorn, Frick, and Reynolds (2001) demonstrated that boys who exhibited antisocial behavior prior to age 10 were more likely to display impulsivity, narcissism, and CU traits than boys who did not demonstrate antisocial until age 11 or after.

It should be noted, at the outset, further research is required to understand the extent to which psychopathic traits, even if present during adolescence, necessarily continue to be present during adulthood. Researchers such as Seagrave and Grisso (2002) have raised concerns in this regard, as well as the appropriateness of applying the construct of psychopathy to adolescents in light of the fact that it is not atypical for adolescents to temporarily display certain isolated aspects of psychopathy as part of a typical developmental progression. Partly as a reflection of these considerations, persons under the age of 18 are generally not formally characterized as "psychopathic," but are instead referred to as "exhibiting psychopathic traits or tendencies" (Andershed, 2010). This characterization is intended to reflect the difference between a trait or individual symptom or behavior, and a more pervasive and extreme cluster of interpersonal, affective, and behavioral factors.

Measures of psychopathy. It is thought that psychopathy can be indexed behaviorally using several different self-report measures. One of these indices, the "Psychopathy Checklist-Revised," or PCL-R (Hare, 1991, 2003), is an interview-based inventory based largely on Cleckley's original list of 16 characteristics of psychopathy. The PCL-R, originally designed for

use in offender populations, is comprised of two factors: "Impulsivity/Conduct" and "Callous/Unemotional" problems. The PCL-R is often considered the "gold-standard" assessment of adult psychopathy.

Psychopathic traits among child and adolescent populations are generally measured by indices that reflect adult measures of psychopathy including the Psychopathy Content scale on the Millon Adolescent Clinical Inventory (Murrie & Cornell, 2000), the Antisocial Process Screening Device (APSD; Frick & Hare, 2001), the Youth Psychopathic Traits Inventory (YPI; Andershed, Kerr, Stattin, & Levander, 2002), and the Psychopathy Checklist-Youth Version (PCL-YV; Forth, Kosson, & Hare, 2003). However, the aspect of measurement of psychopathic traits among adolescents that is most relevant to the focus of this paper is the "callous-unemotional" factor of the Inventory of Callous-Unemotional Traits (ICU; Frick, 2004), described in more detail below.

Summary. "Psychopathy" is a theoretical construct often described as having two "core" components: antisocial behavior and emotional dysfunction. Most of the research to date demonstrating the utility of psychopathy as a conceptual framework for understanding antisocial populations has focused on adults, in which context the construct has been used to identify a subset of antisocial adults that demonstrate severe and persistent patterns of antisocial behavior coupled with interpersonal and emotional deficits.

Given its utility in this context, researchers have begun extending the key components of psychopathy to youth. Similar to psychopathic adults, youth displaying psychopathic traits tend to evidence emotional deficits and antisocial behavior. The next section of the paper describes CU traits among youth.

CU Traits

Definition. Callous-unemotional traits, and correspondingly related impaired affective experience, represent one of the most critical elements of psychopathy (Blair, 2006). Callous-unemotional traits are characterized by diminished empathy, lack of guilt or remorse, manipulation of others, and constricted emotion (White & Frick, 2010).

Genetic influences and stability. Callous-unemotional traits have been demonstrated to have a moderate genetic component. In an analysis of almost 3,500 seven-year-old pairs of twins that were part of the Twins Early Development Study, genetic and environmental influences on CU traits and antisocial behavior were assessed. Among this population, CU traits demonstrated a strong genetic influence, with a group heritability of 67% and minimal shared environmental influence (Viding, Blair, Moffitt & Plomin, 2005). This suggests that 67% of the phenotypic variance, or the CU traits rated separately for each twin, are attributable to genetic influences. The children who demonstrated high levels of antisocial behavior were divided into two groups based on the presence (or absence) or CU traits. The group of antisocial children that ranked high on measures of CU traits demonstrated a group heritability estimate of .81; while in contrast, the group of antisocial children that ranked low on measures of CU traits yielded a group heritability estimate of .30 and a shared environmental influence of .34. Very similar results were reported at a two-year follow-up (Viding, Jones, Frick, Moffitt, & Plomin, 2008). It is observed that the genetic component to CU traits (and more broadly, psychopathic antisocial behavior) likely reflects both the direct effects of genes and gene-environment interactions (Moffitt, 2003).

Interpreting the results of assessments involving CU traits, and understanding the specific implications of the presence of such traits on study results, requires an evaluation of the relative stability of CU traits over time. Recent research has confirmed the relative stability of CU traits

during the period between late childhood to early adolescence (Lynam, Caspi, Moffitt, Loeber, & Stouthamer-Loeber, 2007; Munoz & Frick, 2007; Obradović, Pardini, Long, & Loeber, 2007). For example, a longitudinal community-based study of children conducted by Frick, Kimonis, Dandreaux, and Farrell (2003) reported a CU stability estimate of .71 over four years (with results obtained through parent ratings). In a three year longitudinal study of young adolescents, Munoz and Frick (2007) reported a stability estimate of CU traits of .71 based on parent ratings and a stability estimate of CU traits of .48 based on adolescent self-reports. Research has also confirmed moderate stability of CU traits between adolescence and adulthood. A study published in 2006 by Blonigen, Hicks, Krueger, Patrick, and Iacono found that self-reported CU traits were relatively stable ($r = .60$) from age 17 to age 24; a six-year longitudinal study conducted by Loney, Taylor, Butler, and Iacono (2007) reported moderate stability of CU traits from ages 16 to 18 years (ICC = .40).

Specific manifestations of CU traits among youth. The focus of the discussion of CU traits contained in this paper is adolescents. The presence of CU traits among antisocial youth has been associated with distinctive emotional, cognitive, social and personality characteristics that are described in more detail below. Additionally, among youth that display childhood onset antisocial behavior, the presence of CU traits is associated with particularly severe, aggressive, and long lasting antisocial behaviors (Edens, Campbell, & Weir, 2007; Frick & Dickens, 2006; Frick & White, 2008; Leistico et al., 2008). Following are brief descriptions of some of the specific manifestations of CU traits exhibited by youth.

Difficulty recognizing and processing emotional expressions. Youth with CU traits tend to demonstrate difficulty recognizing and processing fear and distressing emotional stimuli on tasks requiring processing of emotion pictures, words, and vocal tones (Frick & White, 2008).

Evidence also suggests that youth with CU traits have sub-average ability to recognize distress or fear on human faces.

CU and processing of reward and punishment cues. Compared to peers in the community, youth that display CU traits tend to exhibit different responses to punishment cues and rewards (Frick & White, 2008). One aspect of this phenomenon demonstrated by past research is that youth with CU traits appear to focus more on rewards than on potential negative consequences, regardless of the relative magnitudes of each. Accordingly, a particular behavior that has yielded past rewards (especially immediate rewards), may continue to be sought despite the potential for disadvantageous results that would ultimately outweigh any such rewards (Barry, Frick, DeShazo, McCoy, Ellis, & Loney, 2000; Fisher & Blair, 1999; O'Brien & Frick, 1996; Pardini, Lochman, & Frick, 2003). A computerized assessment of "reward dominance" (a title given to the tendency described above) among children with CU traits conducted by O'Brien and Frick (1996) indicated that children with CU traits demonstrated "reward-dominant" response styles. A related conclusion was reached in a study by Barry et al. (2000) that used the same computerized measure; children with CU traits demonstrated more reward-dominant response styles than children with low CU traits. Further support is provided by Blair, Colledge, and Mitchell (2001), who demonstrated that boys with CU traits were significantly more likely to select risky card decks on a computerized gambling task (i.e., card decks associated with short-term rewards and long-term losses) than boys without CU traits. A study by Pardini et al. published in 2003 further confirmed that youth with CU traits tend to focus on the rewarding aspects of aggressive acts while minimizing the potential for punishment as a result of those acts.

Criminal behavior and aggression. Studies of antisocial youth with CU traits demonstrate that these youth tend to engage in delinquent actions at a younger age than

antisocial youth without CU traits (Christian, Frick, Hill, Tyler, & Frazer, 1997; Silverthorn et al., 2001). Additionally compared to their counterparts without CU traits, antisocial youth with CU traits tend to demonstrate more severe and pervasive patterns of aggressive and antisocial behavior, including more frequent conduct problems and police contact (Christian et al., 1997; Frick, Cornell, Barry, Bodin, & Dane, 2003).

Youth without CU traits tend to exhibit mostly reactive antisocial behavior, meaning their aggression tends to be in response to a threat or perceived threat. In contrast, youth with CU traits are apt to demonstrate both reactive and proactive, or premeditated, acts of aggression (Caputo, Frick, & Brodsky, 1999; Frick et al., 2003; Kruh, Frick, & Clements, 2005). Vitaro, Brendgen, and Tremblay (2002) found that youth who engage in proactive acts of aggression are more likely to exhibit delinquency during adolescence and criminality in adulthood than youth whose aggression is limited to reactive acts.

Neuroimaging support. Recent neuroimaging research has by examined the relationship between CU traits and brain structure and reported a positive correlation between youth self-report of CU traits and areas of the brain associated with reward processing (Fairchild et al., 2011). Increased ventral striatal volume, also associated with reward processing, has also been reported among psychopathic adults (Buckholtz et al., 2010; Glenn, Raine, Yaralian, & Yang, 2010).

Measuring CU traits among youth. The Hare Psychopathy Checklist: Youth Version (PCL:YV) developed by Forth et al. in 2003 and the Antisocial Process Screening Device (ASPD; Frick & Hare, 2001) represent the two most commonly used measures of psychopathic traits among youth. However, the PCL:YV includes only four items used to index CU traits and the ASPD includes only six items related to CU traits. There are other limitations to both

measurement scales. For instance, the PCL:YV can only be used with institutionalized populations due to its reliance on data gathered by the relevant institution. The ASPD has broader applicability than the PCL:YV but has limited response choices available to subjects and relies on teacher, parent and self-reports. Due in part to these limitations, in 2004, Frick developed the Inventory of Callous-Unemotional Traits (ICU), which is an expanded version of the CU scale from ASPD. The ICU is used in this study.

Summary. There is strong evidence that children with conduct problems and CU traits exhibit distinctive emotional, behavioral and temperamental characteristics. Consideration of these distinctive characteristics and their influence on resulting antisocial behaviors is critical to designing appropriate prevention and treatment programs.

A DEVELOPMENTAL MODEL OF PSYCHOPATHY: THE INTEGRATED SYSTEMS MODEL

Introduction to the Integrated Emotion Systems Model

Current theories related to the development of psychopathy can be divided into two categories: theories that suggest that psychopathy reflects attention impairment and theories that suggest that psychopathy reflects emotional dysfunction (Blair, 2006). Because this dissertation relates to the intersection between emotion and decision-making as related to risk, it will focus on the theories that postulate that emotional dysfunction is at the root of psychopathy, with specific emphasis on the Integrated Emotion Systems (IES) model of psychopathy proposed by Blair (2004).

Emotional dysfunction models of psychopathy, including the IES, posit that amygdala dysfunction is central to the development of psychopathy (Blair et al., 2005; Kiehl, 2006; Patrick, 1994). However, these models vary with regard to which other neural systems are

identified as additional contributors to, or influences upon, the development of psychopathy and its related functional impairments. The IES model focuses on dysfunction in the amygdala, as well as, dysfunction in the frontal cortex, specifically the ventromedial prefrontal cortex. The IES model identifies the following core functional impairments that are demonstrated by psychopathic individuals based upon amygdala and other brain system dysfunction: emotional learning deficits related to aversive conditioning, passive avoidance learning, response reversal, and processing certain facial expressions. All of the aforementioned impairments are suggestive of general difficulties relating to emotional processing and the related impact on effective decision-making (Blair, 2010; Blair & Mitchell, 2009).

The IES emphasizes the fact that due to amygdala dysfunction, psychopathic individuals are less able than non-psychopathic persons to make use of "moral social referencing." Even before developing the IES model, Blair had long been interested in the intersection of psychopathy and moral development. In connection with his earlier cognitive model, the Violence Inhibition Mechanism (VIM) model, Blair proposed that distress cues triggering sad or fearful responses among typically developing children did not produce similar responses among children with psychopathic traits. Blair posited that without experiencing fearful or sad emotional responses of the type experienced by the general population, individuals with psychopathic traits would be more likely to commit acts of aggression or harm others due to reduced empathy. The IES model incorporates the aspects of the VIM model related to moral social referencing but also recognizes other effects of amygdala dysfunction such as disrupted reversal learning and decision-making, related to the transmission of stimulus-reinforcement information to the ventromedial prefrontal cortex. It is hypothesized that dysfunctions described in the IES model, and the resultant neurocognitive deficits, lead to characteristics exhibited by

psychopathic individuals (including, and especially, those that exhibit CU traits) such as unemotional traits, narcissism, and other behaviors related to emotional regulation and learning.

The following sections will describe the functional implications of the proposed amygdala and prefrontal cortex dysfunction (including the ventromedial prefrontal cortex dysfunction) described in the IES model on expectancies of reward and punishment and related disrupted decision-making processes. Research from behavioral psychological studies supporting the proposed functional areas of impairment will also be presented.

Amygdala Dysfunction

The IES model focuses on the effects of amygdala dysfunction on the development of psychopathy or psychopathic traits. The amygdala, which is an almond-shaped structure located in the anteromedial temporal lobe, is comprised of a bundle of nuclei (Blumenfeld, 2002). The amygdala is extensively connected to other structures in the limbic system, including the hypothalamus, the septal area and basal forebrain, the limbic cortex, the thalamus, and the brainstem.

The amygdala is central to emotional processing and it plays a critical role in responding to expressions of fearfulness and possibly sadness observed in others (Frick & White, 2008; LeDoux, 2007). Researchers have posited that these are key areas of dysfunction related to the development of psychopathy. Based on neurological research to date, amygdala dysfunction appears to have negative consequences for emotional processing as its dysfunction likely inhibits successful communication of signals to other regions of the brain such as the prefrontal cortex. Though research in this area continues to develop, recent neuroscience findings suggest that an intact amygdala is critical for specific types of emotional processing reliant on instrumental learning, or learning to demonstrate specific behavioral responses to gain reward or avoid

punishment, including passive avoidance learning and aversive conditioning (Baxter & Murray, 2002; Blair et al., 2005). Passive avoidance learning tasks require an individual to learn to respond to positive stimuli while withholding responses to negative stimuli. Aversive conditioning tasks require an individual to learn to pair a stimulus with an unpleasant reinforcement (Blair, 2010).

While not all types of instrumental learning are dependent on the amygdala, passive avoidance learning and aversive conditioning occur through direct input from the amygdala through the formation of conditioned stimuli associations (Blair et al., 2005). Stimulus-reinforcement learning is the process by which representations of the conditioned stimuli within the temporal cortex are linked to emotional responses through mediating processes in the amygdala and other brain structures (Blair, 2007). According to Everitt, Cardinal, Parkinson, and Robbins (2003), the amygdala is central to the formation of three types of conditioned stimulus learning that impact emotional learning: conditioned stimulus-unconditioned responses, conditioned stimulus-valenced sensory properties of unconditioned responses, and conditioned stimulus-affect representation associations. An intact ability to utilize stimulus-reinforcement learning is critical to an individual's ability to learn that certain actions or behaviors are likely to harm others and thus should be avoided (Blair, 2007).

Amygdala dysfunction has also been linked to specific impairments in punishment processing, and there is some evidence for impairments in reward processing. In studies published in 2005 and 2006, Blair et al., observed that amygdala dysfunction can interrupt the processing of positive and negative stimuli, including "distress cues." Poor processing of such stimuli can, in turn, impede "emotional learning" or the formulation of affect-related associations to stimuli (Blair, Morton, Leonard & Blair, 2006). In the Blair, Morton, Leonard, and Blair study

(2006), the results of performance on differential reward and punishment learning tasks evidence greater impairments in responses to aversive stimuli among psychopathic males than among males without psychopathic traits. Similarly, in a recent study by Marini and Stickle (2010), researchers administered a Balloon Analogue Risk Task (BART-Y) to a sample of adjudicated adolescents in order to investigate activation of the approach or reward systems among the study participants. Results demonstrated that the study participants exhibiting higher scores on measures of psychopathic traits, specifically CU traits, tended to have lower levels of reward responsiveness than the other study participants.

Several of the effects of amygdala dysfunction among individuals exhibiting psychopathic traits are supported by neuroimaging research. For instance, fMRI images have demonstrated that individuals with psychopathy often present with reduced amygdala volume relative to comparison groups and decreased amygdala activation during aversive conditioning tasks (Kiehl et al., 2001; Viet et al., 2002).

Prefrontal Cortex Dysfunction

In addition to amygdala dysfunction, the IES model also incorporates dysfunction in the prefrontal cortex region of the brain in the following precortical regions: orbital (OFC), ventromedial (vmPFC), and ventrolateral frontal (vlPFC) regions. The prefrontal cortex, through the particular regions described below, is thought to function in tandem with the amygdala with regard to processing stimuli and developing related associations that ultimately influence decision-making. As noted above, the amygdala is thought to output stimulus reinforcement information; regions of the prefrontal cortex, when functioning normally, receive such information and participate in the development of corresponding reward expectancies and associations. The relevance of prefrontal cortex functioning, in addition to amygdala functioning,

on decision-making tasks has been demonstrated through fMRI research (Finger et al., 2008; Kosson et al., 2006). Alternatively, impairments to precortical regions of the brain may be independent of amygdala dysfunction but create additional constraints on brain functions that influence decision-making.

Dysfunction in the prefrontal cortices may lead to functional impairments related to decision-making and differential reward-punishment sensitivity, reversal learning and extinction, and response control tasks. Reversal learning tasks are paradigms where an initially rewarded response is reversed to become the punished response and therefore, an individual must reverse response patterns to be able to continue selecting the rewarded response (Budhani & Blair, 2005; Budhani, Richell, & Blair, 2006). In extinction tasks, the individual must learn to withhold responding all together. In response reversal tasks, the individual must learn to respond to a second stimulus. Common examples of response reversal and extinction tasks include card-playing tasks. Common examples of response control tasks include go/no-go and stop tasks (Blair et al., 2005).

Orbital Prefrontal Cortex (OFC) dysfunction. The IES model acknowledges that while OFC dysfunction may likely be present in psychopathic individuals, it is not conceptualized as the primary cause of brain dysfunction contributing to the development of psychopathy. The OFC is involved with the regulation of emotional behavior (Blair, 2006). Additionally, the OFC has also been linked to decision-making when knowledge about potential rewards and punishment is necessary to guide behavioral responding (Bechara, Damasio, Damasio, & Anderson, 1994; Blair, 2004).

Initial support for the role of the OFC in the development of psychopathy was based in work with OFC lesion patients (Bechara et al., 1994; Blair, 2006). Patients with OFC lesions

have often been described as displaying antisocial and emotionally dysregulated behavior, leading to comparisons with psychopathic individuals (Blair, 2006). Patients with OFC lesions also demonstrate some similar functional impairment to psychopathic individuals, including impaired ability to learn to withhold a now punished response that had been previously rewarded (i.e., response reversal and extinction). Psychopathic individuals do display increased instrumental aggression and more selective impairment in emotion expression recognition than patients with OFC lesions. However, similarities in certain behavioral impairments between the two groups, lends support to OFC dysfunction among individuals with psychopathy.

Ventromedial Prefrontal Cortex dysfunction. The amygdala and vmPFC are highly interconnected brain systems, and it is hypothesized that if the amygdala functioning is impaired, there will be reduced transmission of reinforcement expectancy information to the vmPFC, an area of the brain which then represents this information in a way to help guide decision-making. It is also possible that vmPFC dysfunction independent of reduced communication with the amygdala may also be present. As noted above, Blair and colleagues' studies illustrated that individuals with psychopathy demonstrated impairment on decision-making tasks that subjects could perform successfully only based on stimulus-reinforcement association (Blair, 2007; Blair et al., 2006). VmPFC dysfunction has also been reflected in impairments on "reversal learning," which refers to tasks, or portions of tasks that involve a shift in reinforcement contingencies such that initially rewarded responses become punished. Theoretically, when a response that was originally rewarded instead becomes punishable, the task participant should reverse his or her response pattern accordingly. If the task participant's vmPFC functioning is impaired, that participant may take longer (more trials) than participants with non-impaired functioning to reverse response options, or may be unable to adjust his or her responses to reflect change in the

contingences. Both adults and children with psychopathy and psychopathic traits, respectively, evidence deficits in reversal learning. Deficits in both reinforcement expectancy and reversal learning will contribute to impaired decision-making abilities.

The important roles of both amygdala functioning and functioning of the vmPFC region in performance on tasks was evidenced by the results on corresponding fMRI research (Finger et al., 2008; Kosson et al., 2006).

MEASURES OF DECISION-MAKING AND RISK-TAKING

Introduction to Measurement in Decision-Making

Within the relatively smaller body of research on risk and decision-making focused on adolescents, the majority of studies relied on self-report measures, including delay discounting paradigms where the participant has to choose between a smaller, immediate reward or a larger, delayed reward (Lejuez, Aklin, Zvolensky, & Pedulla, 2003; Reynolds & Mayes, 2012). One of the major findings of these studies is that impulsive adolescents prefer smaller immediate rewards to larger delayed rewards. Although delay discounting paradigms have commonly been used as proxy for decision-making amongst adolescents, recent research has demonstrated that measures of delay discounting may not be capturing the same underlying processes as measures targeted to capture decision-making (Casey et al., 2008; Reyna, 2008). Delay discounting paradigms provide insight into the cognitive aspects of risk in decision-making. A limitation of using self-report measures to assess risk and decision-making is that paper and pencil tasks often lack ecological validity (Reyna et al., 2011).

Several computerized behavioral measures have been developed to address limitations of using self-report measures; these include: the Balloon Analogue Risk Task (BART; Lejuez et al., 2002) and the Iowa Gambling Task (IGT; Bechara, 1994; 2007). Both tasks require participants

to make sequential, repeated decisions for a monetary incentive. Both tasks have been demonstrated to correlate with real-life risk-taking behavior. However, the BART represents a simpler paradigm. The premise of the BART is that the participant is shown a picture of a balloon and asked to repeatedly decide whether or not to pump additional air into the balloon. If the pump is successful, the participant gains 5 cents, if not, the balloon pops and the participant loses all his or her money. There are only two possible outcomes for each decision on the BART: a gain of 5 cents or loss of all money accrued on the task.

In contrast, the IGT represents a more complex task with varied, and uncertain, gain and loss outcomes. Participants are presented with decks of cards on a computer screen arranged in four card decks (A', B', C' and D'), each of which consists of 60 cards. Participants are instructed to select cards from any of the four decks of cards and told that the task is not random and the object is to collect as much money as possible (Bechara, 2007). After each card selection, participants are informed how much money they won or lost as a result of their card selection. A standard administration of the IGT consists of 100 card selections, called "trials," and takes approximately 10 to 15 minutes to complete.

The IGT uses a preprogrammed schedule of monetary rewards and punishments and successful performance requires participants to integrate information regarding rewards and punishments under uncertain conditions. The decks differ in terms of potential monetary gain (or loss) associated with the cards contained in each deck. Decks C' and D' are advantageous meaning that participants who draw primarily from these two decks will have a net monetary gain at task completion. Decks A' and B' are disadvantageous such that if participants draw primarily from these two decks, they will incur a net monetary loss at task completion. The

potential total net gain associated with each of Decks C' and D' is $1,875 and the potential total net loss associated with each of Decks A' and B' is $3,750.

The four decks also differ from one another in terms of the frequency and magnitude of punishment (i.e., monetary loss) associated with the cards contained in each deck. Specifically, Decks A' and C' have more frequent punishments of relatively smaller magnitude, while Decks B' and D' have more infrequent punishments of relatively larger magnitude. After 10 card selections from a single deck, the punishment schedule changes for that deck. There is a 50% probability that one of the first 10 cards drawn from either Deck A' or Deck C' will result in a net loss to the task participant. The frequency of punishment increases by 10% with each subsequent election of 10 cards from a single deck (either Deck A' or Deck C'), however, the magnitude of punishment remains the same throughout the task for cards drawn from these decks. In contrast, there is a 10% probability that one of the first 10 card selections from either Deck B' or Deck D' will result in a net loss to the task participant. For every subsequent election of 10 cards from a single deck (either Deck B' or Deck D'), the magnitude of punishment increases by 10%, however, the frequency of punishment remains the same.

The decks are arranged on screen such that assuming a left-to-right selection strategy, participants are more likely to initially select from the high reward decks (i.e., Deck A' and Deck B'), followed, moving from left to right, by the lower reward decks (i.e., Deck C' and Deck D'; Hooper et al., 2004). Additionally, at the beginning of the task, none of the decks result in immediate punishment, further reinforcing the high reward decks as a better choice. A typical pattern of card selection by a healthy adult might be to initially select from the high reward decks (which are the long-term disadvantageous decks) but then to gradually shift to select cards from

the more advantageous decks, as the initially rewarding decks begin to result in high punishments (Bechara et al., 2000).

IGT participant performance is typically described in terms of total number of cards selected from long-term advantageous decks minus the total number of cards selected from long-term disadvantageous decks [(Deck C' + D') – (Deck A' + Deck B')]. This outcome variable is referred to as the "Net Total." Participant performance can also be considered in twenty card "blocks": card selections 1-20, 21-40, 41-60, 61-80 and 81-100 (corresponding referred to as Blocks 1-5). Using the same calculation used to derive a net total score, a net block score can be calculated for each block.

In contrast to the simpler nature of the BART, the complex nature of the IGT yields detailed data allowing researchers' substantial insight into patterns of decision-making that result in increased risk-taking behavior including aversion to risk, responsiveness to reward and ability to integrate feedback to optimize task outcomes (Steinberg, 2009). For this reason, the IGT was used in this study to assess decision-making behaviors in relation to areas of impairment described in the IES model.

Previous studies that use the IGT to measure decision-making and risk-taking resulting from impairments described in the IES model among (1) adolescents, (2) antisocial populations, (3) youth and adults with psychopathic traits, and (4) youth with CU traits are described below.

Adolescent Performance on the IGT

Performance on a measure of affective decision-making (the IGT) is positively correlated with age between childhood and adulthood such that as participants age, they increasingly demonstrate advantageous patterns of decision-making by selecting cards with long-term gains

(Blair et al. 2001; Hooper, Luciana, Conklin, & Yarger, 2004; Kerr & Selazo 2004). Hooper et al. (2004) demonstrated age-related differences in performance on the IGT among children and adolescents in three age groups (9-10, 11-13 and 14-17 years). Specifically, compared with the younger groups, older adolescents made more advantageous selections on the IGT beginning in Block 4 (cards 61-80). During the final block (cards 81-100), the oldest group continued to choose significantly more advantageously than the youngest participants, there were, however, no longer significant differences between the two older subject groups. Additional support for improved IGT performance during adolescence is from Crone and van der Molen (2004), who utilized a child-friendly variant of the IGT with younger children, adolescents, and adults. Results of this study indicated that adults (ages 18-25) learned to distinguish between advantageous and disadvantageous choices more readily than adolescents (ages 13-15), who demonstrated increased ability to identify advantageous choices than younger children (ages 6-12). A major limitation of the study was the failure to include adolescents aged 15-18 years. Using a modified IGT task which allowed for more detailed consideration of reward seeking and punishment avoidance patterns, Cauffman et al. (2010) found that around 14 years of age, adolescents made proportionally less advantageous card selections than younger adolescents. Cauffman et al. (2010) described that the older adolescents in the study demonstrated greater attendance to potential rewards coupled with less consideration of potential losses than the adults.

In addition to the above findings related to the positive correlation between age and IGT performance during childhood and adolescence, there is some research supporting continued development of the skills required for advantageous IGT performance into young adulthood. Hooper et al. (2004) observed that the oldest group of adolescents in their study scored lower on

the IGT than the average adult performance reported in prior studies (Bechara et al., 2000), suggesting that IGT performance continues to develop into young adulthood. In contrast, Ernst et al. (2003) compared the IGT performance of adolescents to healthy adults and found no significant differences between the two groups. Related, using a modified version of the IGT, Cauffman et al. (2010) did not find significant differences in IGT total score between adolescents (ages 14-17) and adults (ages 18-30).

Given what we know about adolescent brain development, we would expect that adolescent performance on the IGT would improve across adolescence. As adolescents become older, they should become less reliant on emotional pull for immediate gain and more guided by improved cognitive realizations of gradual long-term grain. Research demonstrates that IGT performance improves during childhood and adolescence, and a recent study by Smith, Xiao, and Bechara (2012) documented a curvilinear pattern of improvement. It is somewhat less clear whether IGT performance continues to improve from adolescence into adulthood. Further research is needed to clarify the exact developmental period in which skills related to IGT performance reach maturity.

Antisocial Population Performance on the IGT

It is presumed that, generally speaking, incarcerated persons represent a subset of the population for whom the risk of institutionalization is less powerful than the potential rewards associated with the behavior or behaviors that lead such persons to become incarcerated. For this reason, incarcerated persons represent an ideal group of subjects for research related to specific patterns of decision-making and related attitudes towards risk.

Decision-making studies involving incarcerated subjects. Several recent studies involving incarcerated populations have demonstrated that, when compared to community

samples, incarcerated subjects tend to demonstrate more difficulty adjusting behavior as the result of negative consequences. In a 2004 study conducted by Lewis, Yeager, Blake, Bard, and Strenziok, a sample of 18 men sentenced to execution for felony murder, with an average age of 26.6 years (*SD* = 2.5 years) were given the IGT. Only three of the 18 participants demonstrated decision-making strategies characteristic of community based samples over the course of the task. By the end of the task, 15 of the 18 participants continued to choose disadvantageous cards with approximately the same frequency as they had at the beginning of the task, thereby demonstrating that these participants had not adjusted their behavior to reflect negative outcomes of the task in the way that most community based subjects would. Similarly, a study published in 2008 by Yechiam and colleagues found that none of 81 incarcerated adults (*M* = 29 years) learned to prefer advantageous decks during the administration of the IGT. The results of administration of the IGT to a group of Japanese adolescents (*M* = 15.6 years) who met the DSM-IV criteria for Conduct Disorder, also demonstrated poor performance on the IGT (Miura, 2009).

Associations between decision-making and type of crime. Some of the studies involving performance of incarcerated populations on the IGT considered potential associations between performance on the IGT and the type of crime resulting in the participants' incarceration. The premise of these studies is the idea that individuals who have committed more violent crimes may be more likely to demonstrate impaired decision-making strategies.

Yechaim and colleagues' 2008 study of 81 incarcerated adults grouped study participants based on the crimes for which they were incarcerated. Yechaim and colleagues found individuals who had committed drug-related, theft, or sex crimes were more likely than other study participants to display patterns of poor decision-making characterized by increased attention to

gains as opposed to losses. In contrast, study participants incarcerated for assault, murder, or robbery were more likely to evidence decision-making patterns characterized by disproportionate attention to recent outcomes (regardless of overall gains and losses) and random choice selections. Participants who were incarcerated for murder and assault tended to be most impulsive of all participants, demonstrating strong preferences for immediate rewards and the most random overall card selections of any group. Yechaim and colleagues interpreted these participants' random card selections as indicative of difficulty delaying behavior in favor of long-term gain. Based on these results, Yechaim and colleagues, concluded that, as hypothesized there are discernible associations between types of criminal behavior and specific patterns of decision-making as reflected by performance on the IGT.

Miura, like Yechaim and colleagues, was interested in whether the participants' criminal charges seemed to correlate with their performance on the IGT. Miura divided the participants into two groups, violent and non-violent, depending on whether the crime committed was against another person. He found no significant difference between the violent and non-violent groups with respect to total number of disadvantageous card selections.

Summary. In the studies described above involving incarcerated populations, participants demonstrated poor overall performance on the IGT relative to community populations. Specifically, study participants tended to continue selecting disadvantageous cards throughout the course of the task. Additionally, there is initial evidence of an association between type of crime for which participants were incarcerated and patterns of decision-making and performance on the IGT. This association will be examined in more detail in the data analysis portion of this paper.

The Impact of Psychopathic and CU Traits on Decision-Making Tasks

In a study by Mitchell, Colledge, Leonard, and Blair (2002), adult psychopathic males performed more poorly than comparison subjects on the Gambling Task (Bechara et al., 1994). Using a sample of Dutch university students, van Honk, Hermans, Putman, Montagne, and Schutter (2002) examined the relationship between the IGT and a self-report measure of behavioral activation and inhibition (Behavioral Activation System, BAS; Behavioral Inhibition System, BIS, Carver & White, 1994). The BIS and BAS are used as a proxy for conditioned signals of reward and punishment and were used to divide subjects into groups of low and high psychopathic behavioral characteristics. Results of the study demonstrated a significant interaction for group such that subjects low on psychopathic traits demonstrated more advantageous choices on the IGT across blocks compared with the group high on psychopathic traits. Subjects low on psychopathic traits demonstrated intact punishment learning, which was not demonstrated amongst subjects high on psychopathic traits. The authors observed that subjects high on psychopathic traits performed similarly to those in past studies examining IGT performance amongst patients with orbitofrontal dysfunction, suggesting that subjects high on psychopathic traits may demonstrate worsened IGT performance reflective of their difficulties in affective modulation at the orbitofrontal level (van Honk et al., 2002).

A Canadian study published in 2010 by Bass and Nussbaum documented the results of administration of the IGT to 45 adult forensic psychiatric inpatients, using both the traditional scoring system and a novel system developed by Yechiam et al. (2005). Only a subsample of 12 of the participants completed both the IGT and Psychopathy Checklist-Revised PCL-R. Results including this reduced subsample demonstrated a significant relationship between PCL-R total score and PCL-R facet 4 (antisocial behavior) and IGT Total Score.

Bass and Nussbaum (2010) grouped participants into three categories based on an aggression typology system proposed by Nussbaum, Saint-Cyr, and Bell (1997): predatory, irritable, and defensive aggression. Briefly, predatory aggression is "characterized by an absence of emotional involvement and the requirement of a tangible and identifiable purpose or goal for which the act was carried out." Irritable aggression "is delivered within an envelope of intense anger and typically terminated primarily by the attacker's fatigue rather than by any situational contingencies" and defensive aggression occurs 'in response to a threat of physical attack and injury, generating intense fear in the attacker, and typically a perceived inability to escape the situation unharmed" (Bass & Nussbaum, 2010, p. 369).

When comparing the Predatory group to the combined Irritable and Delusional Defensive aggression groups, the combined group performed more advantageously on the IGT. It is also noted by the authors that the predatory group IGT scores (by block and Total score) fell within the impaired range as categorized by the IGT manual (Bechara, 2007) and the non-predatory group means were all above the impaired range, albeit below the average range of functioning.

The study by Schmitt, Brinkley, and Newman (1999) represents the first investigation of the performance of psychopathic adults on Bechara's four pack card task. The results of this study demonstrated that psychopathic adults performed similarly to comparison subjects. As noted by Blair et al. (2001), Schmitt et al. (1999) did not follow the task instructions as proposed by Bechara.

Blair et al. (2001) utilized two different measures, the Gambling Task (Bechara et al., 1994) and the Intradimensional/Extradimensional Discrimination task (ID/ED; Dias et al., 1996), to investigate orbiofrontal cortex functioning amongst children with psychopathic tendencies. The study authors screened 183 U.K. males between the ages of 9 to 17 years using the

Psychopathic Screening Device (PSD; Frick & Hare, 2001). Based on the subject's score on the PSD, the subject was assigned to either the psychopathic tendency or comparison group. Only 32 boys were given both The Gambling Task and the ID/ED task.

Study authors predicted that the comparison sample of boys would sample from each card deck randomly before developing a preference for the less risky decks, while the sample of boys with psychopathic tendencies would be less likely to demonstrate a preference for the less risky decks. Study authors considered performance on The Gambling Task as the number of cards selected from each of the risky card decks (Decks A' and B') across blocks of 10 cards (10 blocks total). Consistent with study authors' predictions, the sample of boys with psychopathic tendencies were significantly more likely to play from the risky card decks as compared with the comparison sample. As the task progressed, the comparison sample learned to avoid the risky decks.

Summary

Emotion dysfunction accounts of psychopathy point to amygdala dysfunction as at least part of the source of this disruption. The IES model proposes that dysfunction in both the amygdala and areas of prefrontal cortex are present in psychopathy. As described by Blair (2010), emotion dysfunction accounts of psychopathy recognize that the processing of punishment information is disrupted for psychopathic individuals. Both amygdala and orbitofrontal cortex dysfunction have been found to result in poor performance on the gambling task (Bechara et al., 1994; Bechara et al., 1999).

SUMMARY AND STUDY RATIONALE

The study that is the subject of the data analysis portion of this paper attempts to contribute to the existing body of research related to risk-taking and decision-making by

antisocial adolescents. For the purposes of this study, incarceration in a New York correctional facility located at Rikers Island is treated as evidence of study participants' engagement in risk-taking behavior. Further, as imperfect as the association may be, it is assumed that the study participants are "poor" decision-makers in the sense that they have made choices presumed to represent a propensity for favoring immediate or short-term gains over long-term negative consequences (such as incarceration).

The study also examines the application of the construct of psychopathy, manifested, in the case of adolescents, by the presence of psychopathic traits, as a factor influencing decision-making. Only recently have psychopathic traits been considered in the context of adolescents – previous research applied psychopathy, as a construct, almost exclusively to adult subjects. For the purposes of this paper, "psychopathic traits" are defined as traits indicative of psychopathy, a theoretical construct comprised of behavioral, affective, interpersonal, and self-referential features. A key component of psychopathy, and, by extension, psychopathic traits, are "callous-unemotional" (or "CU") traits, which refer to characteristics such as lack of empathy, responsibility, or guilt and a general disregard for others. A developing body of research recognizes the relevance of CU traits to antisocial adolescent behaviors. This paper attempts to contribute to that body of research by examining the association (if any) between adolescent decision-making and CU traits, as evidenced by study participants' performance on the Iowa Gambling Task or "IGT."

Little of the existing literature related to risk-taking and decision-making focuses on adolescents or antisocial adolescents. Additionally little existing research utilizes the construct of psychopathy as a way of understanding antisocial behavior amongst populations other than adult subjects. The study described in this paper attempts to measure the performance on the IGT of a

group of incarcerated male adolescents, and to examine the role, if any, of CU traits exhibited by the study participants on IGT performance. The broader purpose of this research is to help develop a more complete understanding of adolescent decision-making. Only with further inquiry can more effective intervention and prevention programs be designed to dissuade adolescents from engaging in risk-taking or patterns of decision-making that may have very harmful long-term results for them and their communities.

HYPOTHESES

Hypothesis 1

When asked to complete a series of card selections as part of a computerized administration of the IGT, adolescent study participants (incarcerated at Rikers Island Correctional Facility) will make card selections that reflect "poor decision-making" relative to norms established by previous studies for IGT performance among typical adolescents. More specifically, it is hypothesized that study participants, relative to normative samples, will tend to select cards from decks that represent short-term gains but lead to inferior overall performance. In order to empirically evaluate this hypothesis, the Net Total scores of study participants will be compared with Net Total scores of typical adolescents established by previous studies using an independent sample t-test.

Relatedly, it is hypothesized that study participants will make card selections that reflect "poor decision-making" similarly to norms for IGT performance among populations that have also previously demonstrated a propensity for high-risk behaviors, i.e., incarcerated or formerly incarcerated populations. In order to empirically evaluate this hypothesis, the Net Total and Net Block scores of study participants will be compared with Net Total and Net Block scores of a

previously incarcerated sample established by a previous study using an independent sample t-test.

Hypothesis 2

Overall IGT performance, as measured by study participants' Net Total and Net Block scores, is hypothesized to be poorer among the subset of participants incarcerated for violent felonies compared to subjects incarcerated for non-violent felonies or misdemeanors. To test this hypothesis, performance of the study participants incarcerated for violent felonies will be compared to the performance of the non-violent felony or misdemeanor subgroup using either an independent groups t-tests or, if there is evidence of confounding variables, a one-way analysis of covariance. Age, reading scores, and length of incarceration will be considered as potential confounding variables.

Hypothesis 3

It is hypothesized that study participants who report higher levels of CU traits will demonstrate deficits on a task of affective decision-making compared with participants who endorse lower levels of CU traits. Specifically, it is hypothesized that study participants who report higher levels of CU traits will have lower Net Total and Net Block IGT scores than their counterparts that report lower levels of CU traits. Pearson correlations will be used to test this hypothesis. Again, if there is evidence of confounding variables such as age, reading scores, and length of incarceration, partial Pearson correlations will be used to examine the relationships between CU traits and Net Total and Net Block IGT scores, controlling for the effects of the confounding variables.

Chapter II

METHOD

Participants

As part of a group counseling intervention titled "The Power Project" (Principal Investigator, Dr. Noelle Leonard), a cohort of male adolescents ($N = 268$) aged 16-18 years were recruited from a major secure corrections facility in the New York City area between 2009 and 2010. In New York State, adolescents aged 16 and older are considered adults within the justice system. However, adolescents aged 16 years and older but less than 19 years are housed in areas designated for adolescent populations, and research participants were recruited from the two housing areas designated for male adolescents aged 16-18 years at Rikers Island Correctional Facility in New York. Participants were assigned to a specific housing area depending on whether or not they had been sentenced. Fifty five percent ($n = 144$) of the participants were recruited from the housing area designated for adolescents who were convicted and sentenced to a jail term of one year or less and 45 percent ($n = 119$) of the participants were recruited from the housing area designated for adolescents who were detained, indicating that the adolescent had been charged with a crime and awaiting disposition of his case.

In New York State, information about criminal charges, conviction and sentencing for offenders currently and previously incarcerated with the New York Department of Correction is considered public information under the Freedom of Information Law. However, in New York State, some youth ages 16-18 may be classified as youthful offenders (depending on offense committed, the age at which the offense was committed, and at the discretion of the court) and their records are confidential under New York Criminal Procedure Law §720.35. Additionally,

some youth who participated in the current study may have been incarcerated due to crimes committed prior to the age of 16 and thus their records are also confidential.

Public records of the participants' criminal charges at the time of enrollment in the intervention were obtained for the majority of the adolescents (73.8%). Sixty one percent (n = 118) of the participants were charged with a violent felony and 39 percent (n = 76) of the participants were charged with a non-violent felony or misdemeanor. Therefore, 26.2% (n = 69) of the participants were excluded from analyses related to criminal offense as their records were sealed or unavailable.

Procedures

Youth were invited to participate in the study through monthly recruitment sessions held in their housing areas. Research staff introduced the study and described that the purpose of the study was to develop and test counseling programs for young people involved in the correctional system. All interested youth were asked to complete a recruitment form, which was used to determine their eligibility for the study and their emancipation status (if under age 18). Youth were considered "emancipated" if they had fathered a child, were legally married, or were financially independent from their parents/guardians. Youth were deemed eligible to participate in the study if they anticipated having at least six weeks left to serve on their sentence or detention status in order to ensure their ability to participate in the group intervention.

After being recruited for the study, research staff met with eligible youth to further explain the study, answer questions and obtain informed consent or assent. The study protocol was approved by the New York University Committee on Activities Involving Human Subjects and the New York City Department of Corrections. Emancipated 16-17 year olds and youth over the age of 18 were deemed able to give informed consent to participate in the study. Youth aged

16-17 who were not emancipated were allowed to sign informed assent forms and could participate if they assented and study staff obtained verbal consent from the youths' parent or guardian by telephone. Study staff mailed two copies of the parent or guardian consent form along with a stamped, self-addressed envelope for the parent or guardian to mail back one signed copy of the consent form.

Participants did not receive any special legal considerations for enrollment in the study and the program did not have any formal relationship with the parole system. All participants received 25 dollars in their commissary accounts for participation in the baseline interview.

As part of the larger intervention study, participants were asked to complete a 2.5-hour computer-based baseline interview. Youth were informed that as part of the interview, they would be asked questions about their physical and mental health, thoughts and feelings, sexual behavior, and issues related to drug and alcohol use. Youth were also informed that all their responses were confidential; when collecting data from interviewees, identification codes ("ID codes") were used instead of participant names to ensure this confidentiality. A master database on the internal NYU share drive contains research subject identifying information and links research subjects' name to the ID codes. The master database is double password protected and can only be accessed by research staff. NYU staff who are not members of the research team do not have access to the database. All electronic data are kept on a password-protected computer, locked in a secure office space at NYU. With the exception of the master database, all electronic data are numerically coded and contain no identifying information. In addition, a Certificate of Confidentiality was obtained from the US Federal Government to ensure confidentiality. The Certificate of Confidentiality prevents investigators and other project staff from being forced, even by court order or subpoena to reveal research data about subjects.

Each baseline interview was conducted in a private space at the jail with a trained interviewer. There was no corrections officer present in the immediate interview space. All interviewers were Ph.D. psychology doctoral students or research staff members with advanced graduate degrees who received training and supervision from the project coordinator and principal investigators of the larger intervention study. At the time of the baseline interview, each interviewer reviewed the informed consent procedures and answered any questions the youth had regarding the interview or larger study. Each interview was administered on a laptop using an audio-computer assisted self-interview format (ACASI) that was programmed using the Questionnaire Development System (QDS; Nova Research, 2000). In ACASI, the participant listens to digitally recorded questions and response categories through headphones and enters his responses using the computer keyboard. It is noted that at any point during the interview, the participant can opt out of the entire interview or any part of the interview. The ACASI format was used to ensure privacy and confidentiality of responses. The trained interviewer was available during the interview to assist and answer any questions.

The majority of the baseline interview was comprised of self-report assessment measures that used Likert-type or open-ended responses. Participants answered questions about a wide range of topics, including demographic information, history of offending and criminal justice involvement, mental health, sexual health practices, substance use, family environment, and exposure to violence. Participants who reported any suicidal ideation, intent, or action within the past three months were referred to appropriate mental health services. Three computerized tasks were also administered.

Measures

As described above, a variety of self-report measures designed to assess emotional and behavioral functioning were administered as part of the baseline interview. This paper does not address measures used in other portions of the larger intervention study, but what follows is a description of the measures utilized in the present study.

Background and demographic measures. Participants reported on a number of background and demographic variables including their age, race/ethnicity, and educational history.

Criminal history. Information about the primary offense was obtained through the New York City Department of Correction online service and the National Victim Notification Network. All conviction and sentence information about offenders currently and previously incarcerated with the New York Department of Correction is considered public information under the Freedom of Information Law. However, some youth ages 16-18 may be classified as youthful offenders (depending on offense committed and at the discretion of the court) and their records are confidential under New York Criminal Procedure Law §720.35. Additionally, some youth that participated in the current study may have been incarcerated due to crimes committed prior to the age of 16, thus their records are also confidential.

Iowa Gambling Task. The Iowa Gambling Task, or "IGT," was developed at the University of Iowa by Bechara and colleagues (1994). The IGT was originally created to measure decision-making abilities of patients with damage to the ventromedial and orbitofrontal regions of their prefrontal cortices after finding that neuropsychological tasks were not yielding data that adequately reflected these patient's decision-making impairments. Since its development, the IGT has been used to measure risk in decision-making with a variety of populations, including patients with substance use disorders, attention-deficit/hyperactivity

disorders, bipolar disorders, obsessive-compulsive disorders, pathological gambling disorders and psychosis (Bechara, Damasio, & Damasio, 2000).

Though developed to be administered by a live evaluator, the IGT is now more commonly administered via computer (Bechara et al., 2000). Bechara, the original developer of the IGT, has noted in several publications that the computerized version of the IGT is comparable to the paper-and-pencil version (Bechara et al., 1999; Bechara et al., 2000; Schmitt et al., 1999).

Participants are presented with decks of cards on a computer screen arranged in four card decks (A', B', C' and D'), each of which consists of 60 cards. Participants are instructed to select cards from any of the four decks of cards and told that the task is not random and the object is to collect as much money as possible (Bechara, 2007). A standard administration of the IGT consists of 100 card selections, called "trials," and takes approximately 10 to 15 minutes to complete. After each card selection, participants are informed how much money they won or lost as a result of their card selection.

The IGT uses a preprogrammed schedule of rewards and punishments and successful performance requires participants to integrate information regarding rewards and punishments under uncertain conditions. Participant performance can be analyzed in terms of patterns of decision-making, including aversion to risk, responsiveness to reward, and ability to integrate task feedback to optimize task outcomes.

The decks differ in terms of potential monetary gain (or loss) associated with the cards contained in each deck. Decks C' and D' are advantageous meaning that participants who draw primarily from these two decks will have a net monetary gain at task completion. Decks A' and B' are disadvantageous such that if participants draw primarily from these two decks, they will

incur a net monetary loss at task completion. The potential total net gain associated with each of Decks C' and D' is $1,875 and the potential total net loss associated with each of Decks A' and B' is $3,750.

The four decks also differ from one another in terms of the frequency and magnitude of punishment (i.e., monetary loss) associated with the cards contained in each deck. Specifically, Decks A' and C' have more frequent punishments of relatively smaller magnitude, while Decks B' and D' have more infrequent punishments of relatively larger magnitude. After 10 card selections from a single deck, the punishment schedule changes for that deck. There is a 50% probability that one of the first 10 cards drawn from either Deck A' or Deck C' will result in a net loss to the task participant. The frequency of punishment increases by 10% with each subsequent election of 10 cards from a single deck (either Deck A' or Deck C'), however, the magnitude of punishment remains the same throughout the task for cards drawn from these decks. In contrast, there is a 10% probability that one of the first 10 card selections from either Deck B' or Deck D' will result in a net loss to the task participant. For every subsequent election of 10 cards from a single deck (either Deck B' or Deck D'), the magnitude of punishment increases by 10%, however, the frequency of punishment remains the same.

The decks are arranged on screen such that assuming a left-to-right selection strategy, participants are more likely to initially select from the high reward decks (i.e., Deck A' and Deck B'), followed, moving from left to right, by the lower reward decks (i.e., Deck C' and Deck D'; Hooper et al., 2004). Additionally, at the beginning of the task, none of the decks result in immediate punishment, further reinforcing the high reward decks as a better choice. A typical pattern of card selection by a healthy adult might be to initially select from the high reward decks (which are the long-term disadvantageous decks) but then to gradually shift to select cards from

the more advantageous decks, as the initially rewarding decks begin to result in high punishments (Bechara et al., 2000).

Typical IGT scores. The most commonly used IGT outcome variable is "Net Total," which represents the total number of cards selected from advantageous desks minus the total number of cards selected from disadvantageous desks [(Deck C' + Deck D') – (Deck A' + Deck B')]. A positive net total score suggests that the overall decision-making strategy selected by the study participant was advantageous (i.e., favored long-term gains), while a negative net total score suggests that the overall decision-making strategy of the study participant was disadvantageous (i.e., characterized by short-term gains and long-term losses).

Participant performance can also be considered based on card selections considered by "block." The cards can be broken into five "blocks": 1-20, 21-40, 41-60, 61-80 and 81-100 (correspondingly referred to as Blocks 1-5). Similar to the net total score, for each block of twenty cards, the net block score can be calculated by following the same calculation used in the Net Total [(Deck C' + Deck D') – (Deck A' + Deck B')]. Similarly, negative and positive net block scores indicate disadvantageous and advantageous decision-making strategies utilized during specific twenty card blocks.

Additionally, although no normative scores are provided, Bechara and colleagues indicate several IGT descriptive scores including total number of card selections from each deck, total money and reaction time between card selections.

Reliability and validity of the IGT. There are no studies to date that have examined the reliability of the IGT. Related to the current study, several research studies provide preliminary support for age-related changes in IGT performance. IGT performance is positively correlated with age between childhood and adulthood such that as participants age, they increasingly

demonstrate advantageous patterns of decision-making by selecting cards with long-term gains (Blair et al., 2001; Hooper et al., 2004; Kerr & Selazo, 2004). Hooper et al. (2004) demonstrated age-related differences in IGT performance among children and adolescents in three age groups (9-10, 11-13 and 14-17 years). Specifically, compared with younger groups, older adolescents made more advantageous selections on the IGT beginning in Block 4 (card selections 61-80).

The IGT test manual presents validity studies examining the use of IGT among commonly evaluated clinical groups. Although only cited and not presented in the IGT manual, several studies have examined the validity of using the IGT to detect decision-making impairments among individuals with psychopathy. It is noted that varying results have been found. Among the studies that have demonstrated the usefulness of the IGT to identify decision-making impairments among individuals with psychopathic traits include Bass and Nussbaum (2010), Blair et al. (2001), Mitchell et al. (2002), and van Honk et al., (2002).

Inventory of Callous-Unemotional Traits. The Inventory of Callous-Unemotional Traits (ICU; Frick, 2004) is a 24-item self-report questionnaire designed to provide an assessment of callous-unemotional traits in youth. It represents an expansion of the six-item CU scale from the Antisocial Process Screening Device (APSD; Frick & Hare, 2001), an earlier developed measure of CU traits among youth. The self-report version of the ICU was used in the current study (parent and teacher versions are also available but were not relevant).

Adolescents completing the self-report ICU are asked to indicate how well each statement in the ICU questionnaire describes them on a four-point Likert scale ranging from 0 (*not at all true*) to 3 (*definitely true*). Twelve positively worded items (items 1, 3, 5, 8, 13, 14, 15, 16, 17, 19, 23, 24) require reverse scoring before calculation of the total ICU scores. It is noted that in accordance with past studies of detained adolescent males (such as Kimonis, Frick,

Munoz, & Aucoin, 2008), items 2 and 10 were deleted due to low corrected item-total correlations.

The ICU captures three dimensions of CU traits: callousness (e.g., I do not care who I hurt to get what I want), unemotional (e.g., I do not show my emotions to others), and uncaring (e.g., reverse scored: I feel bad or guilty when I do something wrong). Each subscale appears to measure a separate, yet related, construct, thus the use of either the total scale or individual subscales is justified (Essau, Sasagawa, & Frick, 2006; Kimonis et al., 2008). In the current study, both the individual subscales and the total score were used.

Reliability and validity of the ICU. The ICU self-report version has shown adequate reliability in a study using a large, non-referred community sample of German adolescents (aged 13-18 years, n = 1,443; Essau et al., 2006), as well as an American sample of juvenile offenders between the ages of 12-20 years (n = 248; Kimonis et al., 2008), with Cronbach alpha coefficients ranging from.77 to .81. Validity was also demonstrated in both studies, with significant associations found with measures of aggression, delinquency, internalizing and externalizing behaviors, and conduct problems (Essau et al., 2006; Kimonis et al., 2008).
In the current sample, reliability estimates were adequate for the uncaring and callous subscales, with Cronbach alpha coefficients of $\alpha = .83$ and of $\alpha = .76$, respectively. However, reliability estimates of the unemotional subscale were inadequate, with a Cronbach alpha of $\alpha = .33$.

Wide Range Achievement Test –Third Edition. The Wide Range Achievement Test-Third Edition (WRAT-3; Wilkinson, 1993) is an educational achievement battery for individuals' aged 12-75 years. The WRAT-3 is comprised of reading, spelling, and arithmetic subtests. The reading subtest was used in the study described in this paper as an estimate for verbal IQ.

The reading subtest is a measure of letter and word recognition. The subtest is comprised of 15 letters and 42 words, which participants are asked to read aloud. The number of correctly read letters and words are tallied and can be converted to standard scores, percentiles, and school grade equivalents.

In clinical populations of children referred for academic difficulties, the WRAT-3 has shown moderate to high correlations with IQ, ranging from $r = .55$ to $r = .71$ (Smith, Smith, & Smithson, 1995; Vance & Fuller, 1995) and has shown adequate concurrent validity with other academic measures (Flanagan et al., 1997).

RESULTS

Demographic Variables

The study sample is comprised of male adolescents ranging from 16 to 18 years (M= 17.42, SD = 0.71) incarcerated at a major secure corrections facility in New York City. A cohort of 268 adolescents was recruited for participation in the intervention. Due to missing baseline questionnaire data, five participants were excluded from the analyses presented in this paper. Descriptive statistics for the 263 participants (98%) are provided in Table 1.

Forty-four percent (n = 118) of the sample reported to be African American, 27.8% (n = 73) of the sample reported to be Hispanic or Latino and 27.4% (n = 72) of the sample reported to be multi-racial. On average, the participants had completed nearly 10 years of schooling (M = 9.96, SD = 1.29) and the participants WRAT-3 reading scores (M = 38.96, SD = 7.16) indicated that their reading levels are typical of those found among seventh graders.

As described in the Method section of this paper, although arrest records, conviction and sentence information are available through the Freedom of Information Law in New York State, some information may be considered confidential (depending on the age of the offender, type of

offense committed and at the discretion of the court). Information about the primary offense at the time of arrest was obtained for the majority of participants (73.8%) and therefore a reduced sample size (n = 194) will be used in analyses related to criminal offense.

Sixty one percent (n = 118) of the participants were charged with a violent felony (e.g., assault, manslaughter) and 39% (n = 76) were charged with a non-violent felony or misdemeanor (e.g., possession of stolen property, sale of controlled substances, trespassing). The average length of time of incarceration from the participants' arrest to the date of baseline questionnaire was 112 days (SD = 131 days; range 7 - 953 days).

Table 1

Demographic Variables

	N	**Percent**
Age (years)		
16	36	13.7
17	81	30.8
18	146	55.5
Race/Ethnicity		
Black/African American	118	44.9
Hispanic/Latino	73	27.8
Multiracial/Other*	72	27.4
*predominantly Black and Hispanic		
Charged with Violent Felony	118	61
Charged with Non-Violent Felony/Misdemeanor	76	39
Percent with GED	17	11
	M	***SD***
Average Age of Participants (years)	17.42	.71
Estimated Reading Level	7th Grade	---
Length of Incarceration at Baseline Questionnaire (days)	112	131

Variable Exclusion Criteria

IGT Outliers. Prior to providing descriptive statistics for the variables considered in analyses related to the IGT, a screen for outliers among the IGT variables was conducted.

The IGT variables, Net Total and Net Block scores, were standardized using z scores and any observations less than - 3.29 or greater than 3.29, the recommended cutoff scores for identifying univariate outliers, were identified (Field, 2009). Six participants were subsequently excluded as outliers because they had one or more IGT scores beyond these cutoff scores.

Inadequate IGT Deck Sampling. After screening for outliers on IGT task performance, the consideration of whether participants had adequately sampled from each of the four decks was examined. Adequate IGT deck sampling was defined as selecting at least ten cards from each of the IGT decks (given that the IGT reward and punishment parameters shift after ten card selections, for each deck). Participants who sampled less than 10 cards from any of the IGT desks were identified and excluded from analyses related to the IGT. Seventeen participants failed to sample at least 10 cards from each of the four decks. It is observed that 93% of all participants adequately sampled cards from each of the IGT card decks. For all subsequent IGT analyses presented in this paper, a reduced sample size of N = 240 will be used (6 participants were excluded as outliers and 17 participants were excluded for inadequate deck sampling).

A chi-square analysis was used to address whether potential differences exist amongst participants incarcerated for violent felonies and participants incarcerated for non-violent felonies or misdemeanors (the two groups of participants used in Hypothesis 2) and adequate IGT card desk sampling. The results of the chi-square test indicate that there is no significant association between grouping of participant (those incarcerated for violent versus non-violent felonies) and inadequate sampling of IGT card decks (chi-square = 2.2, $df = 1$, $p > .05$).

Descriptive Statistics

IGT. Visual inspection of the univariate frequency distributions of the IGT Net Total and Net Block variables indicated that these variables are reasonably normally distributed. Given that fact, the raw score means and standard deviations of the IGT variables are presented in Table 2.

As seen in this table, each of the means of the IGT variables is negatively signed which, as stated above, indicates a preference for risk-taking relative to risk-avoidance, on average. In addition, a profile plot of the mean values of the IGT Net Block variables is provided (Figure 1).

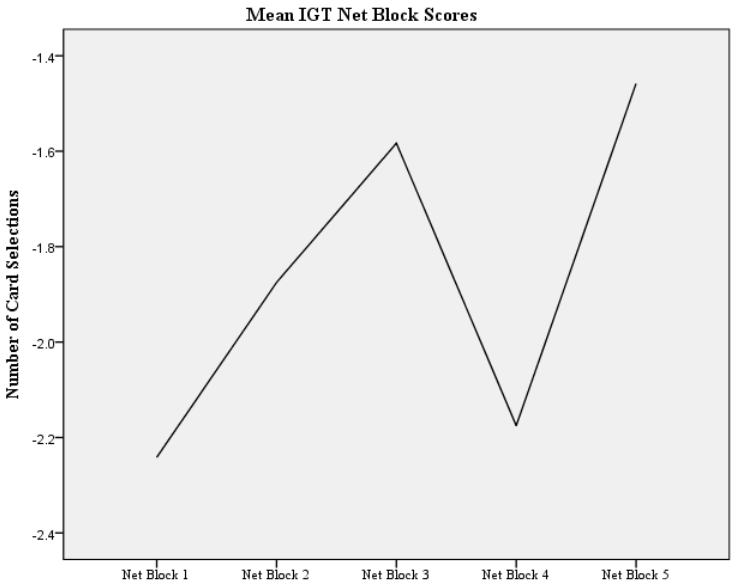
Table 2

Mean IGT Scores

	Net Total	Net Block 1	Net Block 2	Net Block 3	Net Block 4	Net Block 5
M	-9.33	-2.24	-1.88	-1.58	-2.18	-1.46
SD	17.15	4.27	4.26	4.99	5.19	6.23

Figure 1

Profile Plot of Mean IGT Net Block Scores



To further understand IGT performance, a one-way repeated measure analysis of variance was used to examine differences in total number of cards selected from each deck. The results of the repeated measures ANOVA show an overall significant difference between number of card selections across decks, ($F_{(df = 2.21,\ 528.25)} = 62.94$, $p < .001$). The results of the pairwise comparisons demonstrate that participants selected significantly more cards from Deck B than

other decks. The raw score means and standard deviation of number of cards selected from each IGT deck is presented in Table 3.

Table 3

Mean Number of Cards Selected From Each IGT Deck

	Deck A	Deck B	Deck C	Deck D
M	23.50	31.16	22.64	22.69
SD	5.87	9.35	5.12	6.84

ICU. Visual inspection of the univariate frequency distributions of the ICU variables indicated that the three subscales and the total score for this measure are reasonably normally distributed. The raw score means and standard deviations of the ICU variables are presented in Table 4. As displayed, relative to their ranges (maximum scores – minimum scores), this sample is, on average, performing in the middle of the empirically observed range for Uncaring, Unemotional and the ICU Total scores. With respect to the Callous subscale, the sample mean (M = 5.86) is approximately 25% of its maximum observed score (range 0-26) suggesting that the sample may be underreporting on this particular subscale.

As displayed in Table 4, there are slightly varied sample sizes depending on the ICU subscale, which reflects missing data for that particular subscale.

Table 4

Mean ICU Scores

	Callous	Uncaring	Unemotional	ICU Total
N	241	245	243	240
M	5.85	10.73	8.69	25.29
SD	4.25	5.14	2.52	8.07
Range	0-26	0-24	1-15	5-50

Hypothesis 1

The current study represents a preliminary effort to examine IGT performance among a sample of incarcerated youth within the United States. As such, a comparison of the study's sample performance on the IGT to normative adolescent samples (i.e., non-incarcerated samples) is presented in Table 4. It was hypothesized that study participants, relative to normative samples of similar aged peers, will tend to select cards from decks that represent short-term gains but lead to inferior overall performance (i.e., Deck A and Deck B). The Net Total scores of study participants were compared with Net Total scores of typical adolescents established by previous studies using an independent sample t-test.

Following a review of the literature, two comparison samples were selected that used a standard administration of the IGT (and therefore allow for a comparison of IGT Net Total Scores): Hooper et al. (2004) and Ernst et al. (2003). The sample utilized in the study by Hooper and colleagues included adolescents aged 14 to17 years, who were recruited through the Institute of Child Development at the University of Minnesota, Twin Cities Campus. The sample used in the study by Ernst and colleagues was comprised of young adolescents aged 12 to 14 years.

As displayed in Table 5, independent sample t-tests find that the mean Net Total score of the current study is significantly different from both Hooper et al.'s study sample (-9.33 vs. 13.19, $t(50.70) = 6.49$, $p < .001$, Cohen's $d = 1.17$) and Ernst et al.'s study sample (-9.33 vs. 16.30, $t(33.8) = 5.58$, $p < .001$, Cohen's $d = 1.20$). Moreover, as indicated by Cohen's d statistic, not only are these mean differences statistically significant, they are, as expected, substantial.

Table 5

Comparison of Study Sample IGT Total Score Means with Non-incarcerated Adolescent Samples

	Current Sample	Hooper et al., 2004	Ernst et al., 2003
N	240	42	31
M	-9.33	13.19	16.3
SD	17.14	21.31	24.8

In addition to comparing the study participants IGT performance to normative data of similarly aged persons, study participants IGT Net Total and Net Block scores were also compared to those from a previously incarcerated sample using an independent sample t-test (Beszterczey, 2006). It was hypothesized that study participants would make card selections that reflect "poor decision-making" similarly to norms established among a population that has also previously demonstrated a propensity for high-risk behaviors, i.e. a formerly incarcerated population.

Following a review of the literature, only one study was identified that used a standard administration of the IGT with a previously incarcerated sample. No studies were identified that used a standard administration of the IGT with an incarcerated sample (adolescent or adult). The participants in the Beszterczey sample are adults, with an average age of 37.

As displayed in Table 6, independent sample t-tests find that the Net Total score of the study participants is significantly different than the Net Total score of Beszterczey's participants (-9.33 vs. 2.08, $t(263) = 3.10$, $p = .002$). With respect to Net Total score, the study sample exhibits a more risk-taking proclivity than does Beszterczey's previously incarcerated sample.

When comparing the samples on Net Block scores using a series of independent sample t-tests, a Bonferroni correction of .01 was used to avoid inflating the possibility of a Type 1 error. As displayed below, four of the five Net Block comparisons find no significant mean difference

between the study sample and Beszterczey's previously incarcerated sample. Still, visual inspection of the Net Block mean comparisons suggests that the two samples do not meaningfully differ on IGT scores.

Table 6

Comparison of Study Sample IGT Score Means with a Previously Incarcerated Adult Male Sample

	Study Sample	**Beszterczey, 2006**	***t*(df)**	***p***	***D***
N	240	25			
Net Total	-9.33 (17.15)	2.08 (20.88)	t(263) = 3.10	**0.002**	0.60
Net Block 1	-2.24 (4.27)	-.8 (5.80)	t(26.73) = 1.21	0.24	0.28
Net Block 2	-1.88 (4.26)	.64 (4.72)	t(263) = 1.37	0.17	0.28
Net Block 3	-1.58 (4.99)	1.52 (5.87)	t(263) = 2.90	**0.004**	0.57
Net Block 4	-2.18 (5.19)	-.56 (7.95)	t(26.18) = 1.00	0.33	0.24
Net Block 5	-1.46 (6.23)	1.28 (6.71)	t(263) = 2.07	0.04	0.42

Hypothesis 2

Overall IGT performance, as measured by study participants' Net Total and Net Block scores, was hypothesized to be poorer among the subset of participants incarcerated for violent felonies compared to participants incarcerated for non-violent felonies or misdemeanors. To test this hypothesis, performance of the study participants incarcerated for violent felonies was compared to the performance of the study participants incarcerated for non-violent felonies or misdemeanors using an independent group t-test. Hypothesis 2 was also examined using repeated measures of variance analysis, which yielded the same results as the independent groups t-tests, thus only the results of the independent groups t-test are displayed and discussed below.

Prior to testing Hypothesis 2, an examination for potential confounding variables was conducted. More specifically, three variables, i.e., the respondent's age, level of reading achievement, and number of days incarcerated prior to baseline assessment were considered. The

number of days participants were incarcerated prior to administration of the baseline assessment was positively skewed (skew = 3.06) and a log transformation was used to correct the skew.

In order for a variable to qualify as a confounding variable two criteria have to be met. First, the violent and non-violent offenders should differ significantly with respect to age, WRAT score, and length of time incarcerated prior to baseline assessment. Second, and assuming that the first criterion is met; the variables should be significantly related to the outcomes under investigation.

Table 7 includes the findings from independent group t-tests in which the violent and non-violent respondents are compared with respect to their mean scores on age, reading achievement, and length of time incarcerated prior to baseline assessment. As seen in this table, there is no statistical evidence that these groups differ with respect reading level (t (172) = 1.29, p = .19) or length of time incarcerated prior to baseline assessment (t (167) = -0.39, p = .69). At this point, WRAT score and length of time incarcerated prior to baseline assessment can be dismissed as control variables, but their relationships to the outcomes under investigation were nevertheless examined. As there is statistical evidence that the groups differ with respect to age (t (170) = 2.51, p = .01), the relationship between age and the outcomes under investigation was also examined.

However, as seen in Table 8, these three variables fail to exhibit any meaningful relationship to any of the IGT outcomes under investigation. As such, neither age, reading level, nor length of time incarcerated prior to baseline assessment were used as control variables in testing Hypothesis 2.

Table 7

Independent t-tests comparing Violent and Non-violent Adolescents on Age and WRAT and Days Incarcerated

	Group	*M*	*SD*	*N*	*t*	*df*	*P*
Age	Non-Vio./Mis.	17.56	0.61	70	2.51	170	0.01*
	Violent	17.29	0.81	104			
WRAT	Non-Vio./Mis.	39.85	7.56	70	1.29	172	0.19
	Violent	38.44	7.01	104			
Days Incar.	Non-Vio./Mis.	4.23	.98	67	-0.39	167	0.69
	Violent	4.28	1.05	102			

Table 8

Pearson Correlations for IGT variables with Age and WRAT and Days Incarcerated

	Net Total	Net Block 1	Net Block 2	Net Block 3	Net Block 4	Net Block 5
Age	-0.043	-.077	0.088	-0.101	-0.029	-0.021
WRAT	0.004	-.003	-0.005	-0.086	0.112	-0.018
Days Incar.	-0.035	-0.038	0.041	-0.098	-0.011	-0.013

Table 9 presents an independent groups t-test in which the violent and non-violent groups are compared on IGT Net Total score. On average, participants incarcerated for violent felonies scored lower, or more poorly, on the IGT (M = - 11.85, SD = 19.16) than participants incarcerated for non-violent felonies or misdemeanors (M = - 6.39, SD = 15.21). This difference is significant (t (171.18) = 2.10, p = .04) and represents a medium-sized effect (Cohen's d = .32).

Table 9

Independent groups t-test comparing Violent and Non-violent Adolescents on IGT Net Total

	Group	*M*	*SD*	*N*	*t*	*df*	*p*	*D*
IGT Net Total	Non-Vio./Mis.	-6.39	15.21	72	2.10	171.18	**.04**	.32
	Violent	-11.85	19.16	105				

Table 10 presents a series of independent groups t-tests in which the violent and non-violent adolescents are compared on the array of IGT Net Block variables. A Bonferroni correction was used to avoid inflating the possibility of a Type 1 error, thus the probability used for comparison purposes is .01. As seen in this table, using the corrected probability comparison of .01, the violent offenders differ significantly from the non-violent offenders on one outcome, the Net Block 2 score. Still, visual inspection of the group-specific means for each variable finds that the violent group means scores are consistently lower than those of their non-violent counterparts indicating a greater proclivity for risk-taking behavior.

Table 10

Independent groups t-tests comparing Violent and Non-violent Adolescents on IGT Net Block Variables

	Group	***M***	***SD***	***N***	***t***	***df***	***p***	***D***
IGT Net Block 1	Non-Vio./Mis.	-1.64	3.48	72	1.67	172.46	.10	.25
	Violent	-2.65	4.50	105				
IGT Net Block 2	Non-Vio./Mis.	-0.64	3.48	72	3.75	173.82	< .001*	.57
	Violent	-2.91	4.63	105				
IGT Net Block 3	Non-Vio./Mis.	-1.11	5.05	72	1.16	175	.25	.17
	Violent	-2.02	5.18	105				
IGT Net Block 4	Non-Vio./Mis.	-1.61	4.07	72	1.27	174.79	.20	.19
	Violent	-2.59	6.16	105				
IGT Net Block 5	Non-Vio./Mis.	-1.39	5.83	72	0.29	175	.77	.05
	Violent	-1.68	6.85	105				

Hypothesis 3

It was also hypothesized that study participants who reported high levels of CU traits on the ICU would demonstrate deficits on the IGT compared with study participants who endorsed lower levels of CU traits. Specifically, it was hypothesized that study participants who reported higher levels of CU traits would have more disadvantageous Net Total and Net Block IGT scores

than their counterparts who reported lower levels of CU traits. Pearson correlations were used to test this hypothesis.

Contrary to expectation, the correlations between the ICU and IGT measures are neither negatively signed nor statistically significant (all, $p > .05$). That is to say, respondents reporting greater levels of psychopathic traits on the ICU subscales and the ICU total score do not report significantly lower scores, i.e., scores indicating a greater proclivity for risk-taking, on any of the IGT measures. Given that, these data cannot be said to support the claim made in Hypothesis 3.

Table 11

Pearson Correlations for IGT variables with ICU variables

IGT Variable	Callous	Uncaring	Unemotional	ICU Total
Net Total	0.02	-0.02	-.035	-.013
Net Block 1	0.02	-.022	-.059	-.017
Net Block 2	0.02	-0.07	-.078	-.054
Net Block 3	0.03	0.05	-.019	0.04
Net Block 4	-.004	0.02	-.003	0.01
Net Block 5	0.02	-.055	0.01	-.030

CHAPTER III

DISCUSSION AND FUTURE DIRECTIONS

The final portion of this paper provides a summary of the purposes and results of the study and then attempts to interpret the results of the study in the context of the theoretical and clinical implications of the findings. Finally, certain limitations of the study are identified and briefly explored, along with suggested directions for future research.

Summary of Findings

The study examines the performance of a group of incarcerated male adolescents on the Iowa Gambling Task (IGT; Bechara, 2007). As such, the study attempts to add to the existing body of research and literature related to decision-making and risk-taking among antisocial adolescents. In an effort to contextualize the results of the study sample's performance on the IGT, study participant performance was compared to the IGT performance of community-based adolescents and to the IGT performance of a group of previously incarcerated adult subjects. The study also examines the relationship between certain psychological traits, such as delinquent behavior and psychopathic traits, and decision-making. Building on the existing body of research and literature stemming from Blair's Integrated Emotion Systems Model (2006), the study also examines the association, or lack thereof, between adolescent decision-making, criminal behavior, and callous-unemotional traits.

Study overview. Study participants consisted of a group of male adolescents aged 16-18 years incarcerated at a secure correctional facility located near New York City. At the time the subjects completed the IGT, 45% of the study participants had been charged with crimes but not yet sentenced; 55% of the study participants had already been sentenced. 61percent of the

subjects had been charged with a violent felony and 39% of the subjects had been charged with the commission of a non-violent felony or misdemeanor.

Description of subject performance on the IGT. As a group, the study sample consistently chose disadvantageous card selections over advantageous ones throughout the task administration. In typical populations, by the third or fourth 20 card block (i.e., card selections 40-59 or 60-79), individuals demonstrate a pattern of advantageous card selection. In the study sample, there was no indication of meaningful improvement in participants' ability to integrate task feedback on any 20 card block.

Study participants selected significantly more cards from Deck B, which is characterized by both large monetary rewards and much larger (though infrequent) monetary losses or punishments, than any other deck. Though only one of every 10 cards in Deck B results in a "punishment," the monetary loss associated with each punishment card in Deck B is so large that it cancels out monetary gains a participant may have accrued during the previous 10 card selections from Deck B. Thus, continuing to select cards from the extremely "risky" Deck B demonstrates a clear pattern of high-risk behavior.

While the study results show a pronounced pattern of disadvantageous decision-making amongst the sample as a whole, the results also reflect variation in individual performance. Study participants' net total scores ranged from -64 to 54. This range indicates that, although performance by the sample taken as a group was disadvantageous, certain participants were able to use task feedback to select cards consistent with long-term gain.

***Hypothesis* 1.** The first hypothesis examined the performance of the study population (incarcerated adolescent males, ages 16-18) on the IGT relative to community-based adolescent samples reported by Hooper et al. (2004) and Ernst et al. (2003). As predicted, study participants

performed significantly worse on the IGT than the adolescents in the community-based samples. Study participants appeared much less able than community-based samples to successfully integrate feedback regarding reward and punishment in the decision-making strategies they employed over the course of the task. This outcome confirms that as a group, study participants are significantly more inclined toward risk-taking behavior than their peers in the community as measured by performance on this computerized task.

Study participants' IGT performance was also compared to the performance of a sample of previously incarcerated adults (Beszterczey, 2006). Although the study participants exhibited a greater proclivity for risk-taking overall, there were no statistically significant differences between the performance of study participants and the performance of adult participants in Beszterczey's sample within any group of 20 card selections, with the exception of Net Block 3. This finding is also consistent with Lewis et al. (2004), Yechiam et al. (2008), and Miura's (2009) studies of IGT performance of detained and incarcerated sample adolescent and adult populations. Like those studies, the current findings show much greater similarities between IGT performance of the incarcerated and previously incarcerated subjects than the two sample adolescent populations (never incarcerated).

Although, as stated above, there were no statistically significant mean differences in performance on any group of 20 card selections by this study sample compared to the sample reported by Beszterczey in 2006 (with the exception of Net Block 3), a comparison of the two samples' overall scores reveals greater proclivity toward risk-taking by the adolescents than by Beszterczey's adult sample. This finding can be interpreted to suggest that adolescents as a group are more likely to elect high-risk outcomes than adults, which is consistent with previous studies such as Hooper et al. (2004).

Hypothesis 2.The second hypothesis examined whether there appeared to be any relationship between study participants' IGT performance and primary offense with which the participants were charged. It was hypothesized that study participants accused of committing violent felonies would perform more poorly on the IGT than study participants charged with non-violent crimes or misdemeanors. The mean Net Total score of participants charged with violent felonies was worse (lower) than the mean Net Total score of participants charged with non-violent crimes or misdemeanors. However, with the exception of the second 20 card selection block, the differences between the groups' respective overall net scores were not statistically significant. It is noted that during the first 40 card selections, task participants have not had enough opportunity to explore the win and loss contingencies of the various decks. Thus, without a clear pattern of differences other than in the second 20 card block, the significant difference in the second block may not be particularly meaningful. The results of this hypothesis suggest that the violent versus non-violent nature of the crimes with which the study subjects were charged is not be the best predictor of their IGT performance.

Aggression and violent acts can be expressions of antisocial or, in some cases, psychopathic traits. Viewed in this light, the differential in mean scores (although not significant) between the study participants charged with violent versus non-violent primary offenses supports the possibility of a connection between psychopathic traits (either antisocial traits or callous-unemotional traits) and IGT performance by adolescents. This possible connection is explored further in the discussion of Hypothesis 3.

Hypothesis 3. The third hypothesis tested relates to the degree of association between psychopathic traits, specifically CU traits, and IGT performance. Based on the Integrated Emotions Systems model, it was hypothesized that study participants who reported high levels of

CU traits would make more disadvantageous decisions during an IGT task administration as compared to study participants who endorsed low (or lower) levels of CU traits on a self-report measure. A comparison of correlations between scores on the ICU (a self-report measure of CU traits) and IGT performance revealed that, contrary to expectations, high ICU scores were not correlated with poor IGT performance. Although none of the correlations were statistically significant, it was determined that there was sufficient variability of IGT and ICU scores (based on an examination of the SD) to reject a restricted range of scores as a possible explanation for the weak, insignificant correlations.

There are a number of possible theoretical interpretations of this result, including, but not limited to, that CU traits do not appear to be a determinative influence on IGT performance. It is also possible that the self-report measure used to assess the presence or absence of CU traits amongst this population underreported the presence of CU traits. The clearest conclusion from this result is that further research is warranted to determine whether the absence or presence of CU traits is relevant to adolescent decision-making and risk-taking.

Theoretical and Clinical Context of Results

As described in the literature review portion of this paper, adolescence is a developmental period often associated with increased risk-taking compared to childhood or adulthood. Researchers have identified a number of factors that may contribute to increased risk-taking during adolescence, including: limited ability to coordinate emotion and reason in decision-making due to neurodevelopment, heightened sensitivity to reward, poor behavioral control, labile affect states and increased influence of peer relationships. Some of these same factors may have contributed to the disadvantageous performance of this study population on the IGT.

IGT performance may also have been influenced by other factors. Affective factors, such as callous-unemotional traits, and environmental factors such as being incarcerated, socio-economic status, family relationships and environment, perceived opportunities within subjects' communities and exposure to risk-taking and delinquent behaviors, may also help explain the study samples' performance relative to samples of adolescents in the community. Following is a discussion of some of the factors that may have influenced this study sample's poor IGT performance, explored in the context of theoretical models and potential clinical applications.

Adolescent reasoning ability. As described in previous portions of this paper, historical theories attributed adolescent risk-taking to adolescents' inferior reasoning abilities as compared to adults. The results of this study do not support these theories in the sense that the adolescent participants performed significantly worse on the IGT than samples of community-based adolescents' but not meaningfully worse than a (purportedly) similar adult study population.

Consistent with the results of this study, more recent research has demonstrated that adolescents generally possess basic information processing and logical reasoning abilities (cognitive capabilities that are crucial to decision-making) comparable to those of typical adults (Reyna, 2008; Steinberg, 2008). Further, adolescents are generally as able to estimate and perceive their own vulnerability to risk as adults (Steinberg, 2008). Participants in this study demonstrated average word reading (WRAT) scores equivalent to a seventh grade level. Although these scores are a gross proxy for intellectual abilities, they suggest that participants' cognitive reasoning abilities are well developed enough for study participants to have been able to incorporate task feedback into decision-making strategies over the course of the IGT administration. However, in this study, participants, considered as a group, clearly did not

successfully learn from previous trials over the course of the task, thereby suggesting that there are other factors impacting participants' IGT performance. Stated another way, if age contributes to the adolescent study participants' poor decision-making, the effects were not the result of cognitive limitations.

The "Dual Systems" developmental model. The "dual systems" model, developed by Casey et al. (2008) and Steinberg (2008), offers a neurodevelopmental explanation for greater propensity for risk-taking during adolescence compared to childhood or adulthood. The dual systems model asserts that during adolescence, youth have limited ability to coordinate emotion and reason in decision-making, largely resulting from asynchronous development of the subcortical and cortical regions of the brain during this developmental stage.

In keeping with the dual systems model, it was predicted that if adolescents have limited abilities to coordinate emotion and reason in decision-making compared to adults, the adolescents participating in the current study should perform significantly worse on the IGT than a sample comprised of previously incarcerated adults (a sample presumed similar to the current sample, other than with respect to age). Although the participants in the current study demonstrated a greater proclivity toward risk-taking than the adult sample, when performance was considered in 20 card blocks, there was no meaningful difference in performance between the adolescent study sample and adult sample. In contrast, when the study sample was compared with community-based samples of same-aged peers, the study sample performed significantly worse. These findings suggest that the "dual systems" model alone does not explain study participants' performance on the IGT.

Other neurodevelopmental considerations. It is possible that there are neurodevelopmental reasons for study participants' poor IGT performance that are not captured

by the "dual systems" model. For this study sample, taken as a group, the saliency of rewards clearly appears to exceed the threat associated with punishment or loss. Having neurologically "hardwired" reactions of this type could explain why most of the young men in this sample very clearly attended to rewards to the detriment of incorporating punishment feedback into their decision-making strategies over the course of the task. This finding dovetails with research that suggests punishment oriented or tough sanction approaches with delinquent and antisocial youth do not typically defer re-offending behaviors (Scott & Steinberg, 2008; Greenwood, 2006).

The significant impact of neurological factors on decision-making and human behavior generally has been well documented in many contexts. Among these are Damasio's 1994 study (described in previous parts of this paper) of patients with ventromedial prefrontal lesions, suggesting that brain lesions in these areas affected by the ability to generate somatic markers of the type that help most people distinguish between advantageous and disadvantageous choices. Bechara's seminal 1994 study also documented the impact on IGT performance of an individual's ability to use somatic markers and emotional cues in the ways typical of people without neurological problems. Neurological and neurodevelopmental characteristics of this study population were not measured as part of this research, but should be assessed as part of future similar research efforts.

Antisocial traits. If it is assumed that the behavior that led to participants in this study being incarcerated can be characterized as "antisocial," then the results of this study are consistent with previous research and literature suggesting that individuals with antisocial traits tend to exhibit disadvantageous decision-making strategies. When taken a step further, this finding, and the previous research with similar results, leads to a plausible prediction that the most antisocial members of this study population would perform most poorly on the IGT.

Previous studies such as a study conducted by Yechiam and colleagues in 2008 have analyzed IGT performance in relation to the primary charge of participants. The data collected in this study do not provide longitudinal or observation-based means of distinguishing which study participants display sociable versus antisocial traits. For the purposes of hypothesis two (described above), it was therefore assumed that study participants charged with violent crimes are more likely, as a group, to display antisocial traits than those charged with non-violent crimes.

In this study, contrary to expectations based on review of relevant literature, there was no discernible relationship between participant IGT performance and the crime (violent or non-violent) with which a subject had been charged. In terms of clinical applications, this finding suggests that factors other than antisocial traits or propensity for violence should be considered in designing interventions aimed at changing decision-making patterns among similar populations.

CU traits. The construct of psychopathy, applied in the context of adult populations, has proven helpful to researchers attempting to characterize and identify a subset of antisocial adults who tend to demonstrate severe and persistent patterns of violent and antisocial behavior coupled with interpersonal and emotional deficits. In research concerning incarcerated adults, the presence of psychopathic traits has been found to be associated with higher than average likelihood of recidivism and propensity to commit severe, violent crimes (Blair et al., 2005).

To date, researchers have tended to apply the construct of psychopathy to adult populations. However, recent research has explored the utility of applying certain traits commonly associated with adult psychopathy, specifically callous-unemotional (CU) traits, to adolescent populations. A callous-unemotional traits specifier has been proposed as an addition

to the diagnostic criteria for Conduct Disorder in the upcoming DSM-V. As proposed, this CU trait specifer would be used in conjunction with current childhood, adolescent and unspecified onset specifers (Frick & Moffitt, 2010, APA).

In addition to its potential clinical relevance for diagnostic purposes, CU traits may have important ramifications for treatment of youth that display these traits. Recent research has indicated that youth who display CU traits appear to be more focused on potential rewards than potential negative consequences (Frick & White, 2008). Building on these findings, several recent studies have documented behavioral and psychosocial improvements resulting from interventions involving youth with CU traits when those interventions included reward-based behavioral modification principles (Salekin, 2010; Caldwell, McCormick, Umstead & Van Rybroek, 2007; Caldwell, Vitacco, & Van Rybroek, 2006; Haas, Waschbusch, Pelham, King, Andrade, & Carrey, 2011).

In the current study, no relationship was identified between participants' score on the ICU self-report measure of callous-unemotional traits and IGT performance. This result lends itself to a number of possible interpretations. These include that callous-unemotional traits may be closely linked to high-risk decision-making only during adulthood, possibly because CU traits may not be fully manifested during adolescence. Another possibility, explored further below, is that the participants' self-reported ICU scores do not necessary correspond to how participants would behave when faced with real-life decisions. What is clear is that the current study results do not suggest a correlation between high levels of CU traits reported on the ICU and poor IGT performance

Environmental factors. There are numerous environmental factors that may have affected study participants' IGT performance. Most of these factors were not, by design,

specifically assessed as part of this study. A few of the environmental factors that seem most likely to potentially have impacted participant IGT performance are briefly described below.

Incarceration. As noted in other portions of this paper, this sample of incarcerated adolescents' overall IGT performance was significantly inferior to the IGT performance of community-based samples of adolescents. For most of this paper, incarceration is treated mainly as a factor used to identify appropriate subjects for this study (namely persons who appear likely to have engaged in high-risk behaviors or decision-making). At the same time, it is important to recognize that the experience of being incarcerated at the time of the IGT administration may well have impacted participant performance. As observed by Steinberg, Chung, and Little (2004), "the most potentially damaging aspect of adolescents' passage through the justice system is its effects on individuals' sense of competence and orientation toward the future" (p. 29). Incarcerated adolescents may perceive their own futures quite differently than their peers in the community, perhaps increasing the salience of immediate rewards compared to long-term payoffs. These effects may be further exacerbated by the daily living conditions in a locked facility where there is little or no incentive to delay gratification because there is no guarantee the opportunity for gratification will re-arise.

Psychosocial and emotional factors. There are many other psychosocial and emotional factors that may have affected study participants' IGT performance. For example, the importance of consistent parenting and emotional support during childhood is well recognized. Childhood onset of antisocial behavior is associated with familial instability, conflict, maltreatment, and ineffective parenting techniques (Cicchetti, Rogosch, & Thibodeau, 2012; Frick & Viding, 2009; Jaffee, Caspi, Moffitt, & Taylor, 2004). As noted above, during adolescence, pre-existing and new insecurities may seem especially emotionally salient.

Other social factors almost certainly had some degree of influence on study participants. For example, previous studies have documented links between socioeconomic status and antisocial behavior, as economic status may limit an individuals' ability to engage in pro-social behaviors to obtain goals (Blair, 2006). Indeed, in the New York City area, 14 of the most impoverished neighborhoods account for half of all New York City jail discharges (Mellow et al., 2008). Impoverished neighborhoods can be characterized by higher levels of poverty, economic inequality, and restricted access to quality schools and pro-social employment opportunities. These environmental and contextual factors partially determine opportunity and accessibility for engagement in high-risk behaviors and decision-making as well as study participants' attitudes towards risk-taking. Exposure to community crime and racial discrimination are also associated with delinquent behaviors (Simons & Burt, 2011). Researchers have found that participants who rated their neighborhoods are more disorderly (on similar social characteristics as described above) were more likely to make increasingly risky choices on a computerized measure of decision-making.

When considering the clinical implications of the findings of this study, the results must be tempered with an understanding of how psychosocial factors may also have impacted study participant performance. Study participants' pattern of disadvantageous IGT performance may partially reflect a lifetime of limited opportunities to engage in pro-social decision-making combined with the necessity of selecting immediate rewards rather waiting for long-term payoffs.

Summary. The most likely explanation for the IGT performance of this study sample, as a whole, is that that there are multiply determined reasons for participants' poor performance relative to adolescents included in community-based samples. As the more nuanced study results

described above indicate, no single factor (e.g., simply being an adolescent) seems to determine how an individual performs on the IGT. This result seems consistent with everyday experience in that almost no human decision is made entirely in a vacuum – each decision is the product of multiple factors, some of which build on one another and some of which conflict.

Poor decision-making and related engagement in high-risk behavior can have long-lasting negative consequences on the physical and mental health of adolescents. Relevant to the current sample, incarcerated adolescents appear to represent a population that is especially vulnerable to, or inclined towards, high-risk decision-making. Enduring periods of incarceration can create on-going legal, financial, educational, and professional problems for youth, their families and their communities. Further, criminal activity resulting from poor decision-making has tremendous social implications, including, but not limited to, pain and suffering of victims, concern over safety in the community, and the diversion of vast resources (that could be used for other purposes) to the criminal justice system. For all of these reasons, understanding how incarcerated adolescents approach risk and then learning how psychologists and other mental health professionals, law enforcement personnel, correctional staff and the justice system can help incarcerated adolescents make more advantageous decisions going forward is an important endeavor from the point of view of those individuals and from the perspective of society at large.

Clinicians and researchers need to develop a fuller understanding of adolescent decision-making, including identifying individual differences and psychosocial markers for propensities for poor decision-making, in order to develop interventions that can effectively encourage those adolescents that may otherwise be disinclined to make advantageous choices when faced with "risky" decisions.

Limitations and Directions for Future Research

As in any empirical investigation, the results of this study must be considered in light of the limitations of the research. Following is a discussion of some of these limitations, along with suggested directions for future research.

External validity. One of limitations of this study is its results are somewhat difficult to generalize. A commonly accepted definition of external validity proposed by Shadish, Cook, and Campbell (2002) describes external validity as the extent to which the populations, settings, treatment variables and measurement variables of a study can be generalized beyond that particular study. For purposes of this paper, these components of generalizability are described in terms of population validity and ecological validity.

Population validity means the extent to which the results of a study can be extrapolated to a population as a whole. The sample in the current study was comprised of a group ($N = 263$) of male adolescents aged 16-18 incarcerated in a secure correctional facility in the New York City area. It is noted that the overall sample size was reduced by 69 participants (in analyses related to type of criminal charge) due to the fact legal confidentiality requirements prevented the research team from obtaining records concerning crimes committed by persons under the age of 16 or records that were sealed at the discretion of the court. At the time the IGT task was administered in the current study, more than half of the study participants had been charged with a violent felony such as murder, armed robbery, or assault. In other words, a majority of this sample is comprised of severely violent and antisocial young men.

Further, it is possible that the study results may reflect neurodevelopmental characteristics specific to this relatively narrow age range, particularly because, all of the subjects that participated in the current study were between 16 and 18 years old. As previously

described, adolescence is a period of rapid brain growth and maturity, especially in the areas responsible for coordinating cognitive control and emotion regulation (Casey et al., 2008; Steinberg, 2008). It is therefore possible that the findings of this study would not apply to adolescents of other ages.

Ecological validity describes the extent to which a testing environment influences, or may have influenced, subjects' behavior. In the current study, all of the adolescent participants were incarcerated at the time of the IGT task administration and baseline interview. As described in more detail above, being incarcerated may have affected study participants' performance on a task of affective decision-making. This too limits the generalizability of the study results to adolescents who may have engaged in delinquent or antisocial behavior but are not themselves incarcerated.

Another aspect of the testing environment of this study further strengthens the likelihood that ecological or environmental factors may have influenced study results: the New York State justice system places adolescents aged 16 and older in adult correctional facilities and also sentences them like adults. Accordingly, the results of this study may not be generalizable to adolescents incarcerated at youth or adolescent correctional facilities. Study results may also not be generalizable to adolescents incarcerated in jurisdictions where, if convicted, they are unlikely to face as stringent punishment as if they were sentenced as adults.

Although not examined in this study, there are a number of additional socio-economic considerations that may have impacted IGT performance of this study sample. For instance, as noted above, research has consistently demonstrated that adolescents who reside in impoverished and disadvantaged areas are disproportionally represented in the juvenile justice system (Nicholson-Crotty, Birchmeier, & Valentine, 2009). It is possible that a study sample with

different socioeconomic profiles from the participants in this study might have performed differently on the IGT.

Limitations of study measures and design. Following is a discussion of some of the principal limitations of the measures used in this study as well as its design.

ICU. Information regarding CU traits was gathered using a self-report measure, the Inventory of Callous-Unemotional Traits (ICU; Frick, 2004). Previous research using the ICU has documented its construct validity in a variety of populations (e.g., Essau et al., 2006; Kimonis et al., 2008). In the current study, the distributions of the ICU variables, the three subscales and the total score, are reasonably normally distributed. However, study participants reported lower levels of callousness than youth in other samples, suggesting that the sample may be underreporting on this particular subscale. Additionally, the reliability of the unemotional subscale was extremely low. Given this, the study results would be more reliable if data included collateral information corroborating study participants' self-report of CU traits.

It is not difficult to see how a self-report measure of CU traits might pose problems in this particular context as the usefulness of self-report measures inherently depends upon the reliability of information provided by the study participants. It is conceivable that participants' responses to self-report measures may have been affected by a fear that their responses would not be kept confidential or might somehow impact their legal status. Furthermore, study participants self-reported responses may have been affected by emotional trauma resulting from incarceration or events leading to their incarceration. Emotional states change over time and it would have been preferable to include collateral information in the current study, over a period of time to lend additional validity to help clarify the role of CU traits in study results.

Primary criminal charge. Data collected for this study includes the primary crime with which each study participant was charged at the time of his arrest. This information was gathered from publically available records; primary offenses were then separated into "violent" and "non-violent" categories. There are several potential limitations to this approach. First, the primary offense recorded at the time of a study participant's arrest may reflect incomplete information about the criminal actions (if any) actually taken by the study participants. Whether a participant had been charged with a crime at the time of IGT administration, versus having been convicted and sentenced at the time of task completion, also was not analyzed in the current study. Further, due to restrictions prohibiting researchers from accessing official records of study participants' past criminal activity, study data also did not include study participants' prior criminal records, history of previous incarcerations or other interactions with the criminal justice system. All or any of these factors may have impacted decision-making during the IGT task administration.

WRAT. The reading subtest from the Wide Range Achievement Test – Third Edition, which requires subjects to read aloud words from a list, was used to approximate the verbal IQ of study participants. Reliance on this measure as the exclusive source of information about study participants' overall cognitive functioning means that study results leave open the possibility that cognitive abilities other than Verbal IQ may have influenced study results. In future similar studies, it may be useful to expand the measures battery to include a comprehensive measure of intellectual functioning so as to examine decision-making in the broader context of overall cognitive functioning. This approach would allow for researchers to consider of the potential impact of working memory and other executive functions on decision-making.

IGT. Neurodevelopmental research suggests that the IGT is a sensitive measure of vmPFC damage and related emotion-based decision-making impairments. A substantial body of

literature supports the IGT as a valid measure of affective decision-making among a range of clinical populations and developmental stages. There are, nevertheless, some inconsistent findings in past studies involving the IGT. This may be partially attributable to the fact that there is not currently a standardized IGT scoring paradigm for individuals under the age of 18 years. Some researchers working with young populations have used scoring techniques that deviate from the scoring paradigm suggested in the IGT manual, making it difficult to compare outcomes across studies. Also, there is little data regarding the test-retest reliability of the IGT; no information about test-retest reliability is provided in the test manual. Finally, future research should continue to analyze the stability of IGT performance in conjunction with real-life decision-making behavior.

While the IGT approximates real-life decision-making based on monetary rewards and punishments, it is possible that a measure of affective decision-making based on interpersonal gain may more accurately reflect the decision-making deficits demonstrated by youth with CU traits.

Consideration of additional variables. There are a number of psychosocial factors related to decision-making that are not the main focus of the current study, but should be included in future research; these factors include, but are not limited to, peer influence, emotion regulation, and future orientation (Steinberg, 2009). Further, this study did not focus on the role of mental health in affective decision-making. As part of the baseline interview, adolescents in the current study were asked about any past or current mental health problems. The self-reported incidence rate of mental health problems was so low that mental health variables were not included in the analyses. Future studies may wish to consider the impact of mental health on

decision-making despite the low incidence rate in this sample, as it is possible that the participants underreported symptoms.

Additional Directions for Future Research

Many of the author's suggested directions for future research are described within the foregoing discussion of study limitations as well as in other portions of this paper. Including more information about study participants' personal histories (including family influences, exposure to violence, past criminal or delinquent history) and mental, neurological and general physical heath in data collected for future studies may help to more fully explain the multiply determined influences on risk-taking. Another area meriting future research is whether a more specific analysis of trial-to-trial card selections, in contrast to the available average number of card selections across the task, would demonstrate a more meaningful relationship between type of crime and IGT performance.

Finally, using neurological imaging during task administration, coupled with an inventory of study participants' emotions (recorded through questioning as well as somatic markers) during the course of intake interviews as well as during IGT task administration may help provide valuable further insight into the role of emotion in adolescent decision-making.

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